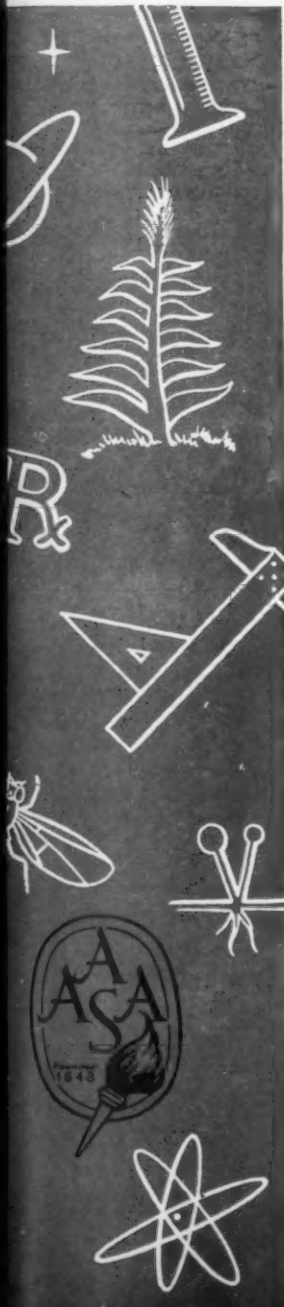


SCIENCE



JUNE 13, 1952

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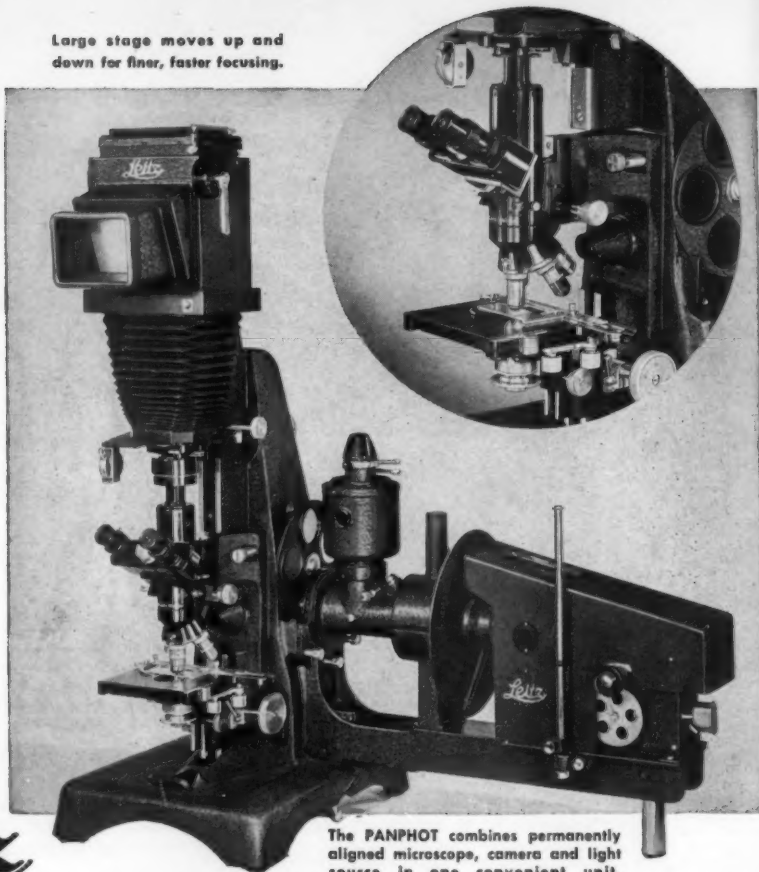
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Poliomyelitis Viruses in Tissue Culture

BECAUSE the study of virology, like that of other sciences, is limited to available techniques, the introduction of a new method makes new observations possible and broadens the scope of inquiry. That the introduction of tissue culture methods for the study of poliomyelitis virus by Enders, Weller, and Robbins in 1949-50 has accomplished this result was demonstrated in a series of papers presented at the 1952 meetings of the American Association of Immunologists and the Society of American Bacteriologists. Growth of virus is accompanied by cytopathic changes readily observed in test tube cultures of cells. Inhibition of these changes by addition of specific immune serum provides the basis of an *in vitro* method for antigenic classification of poliomyelitis viruses, and quantitative estimation of type-specific antibody, thus making possible the *in vitro* serodiagnosis of poliomyelitis infection. The method has not only supplemented, but for many purposes replaced, the cumbersome and expensive procedures required when studies are carried out in monkeys.

Enders used human tissues, chiefly embryonic, for his work, but the need for this has now been partly offset by the finding that monkey testicular and kidney tissues serve admirably for supporting virus growth. Work with human tissues continues to be of utmost importance, for interaction of virus with tissues of the natural host may be directly studied. When passed through human nonnervous tissue, the Brunhilde strain diminished in pathogenicity for monkey CNS. With passage of the Y-SK and Lansing strains through monkey tissue, both almost lost their capacity to produce paralysis in mice, but retained their virulence for monkeys. The possibility exists that the pathogenic potential may be maintained for the host species in whose tissues the virus is being grown, even though the virulence for other species may be markedly diminished.

Rapid isolation and typing of strains using monkey tissue cultures have already shown that during a single outbreak one antigenic type (Brunhilde) predominated, but that the two other types of poliomyelitis virus were also prevalent. Three other cytopathogenic agents were isolated during the outbreak; two were Coxsackie viruses, and one has not yet been classified. Isolations of similar agents have also been made in human tissue cultures.

Roller tube-grown virus has provided a source of antigen that reacts in the complement fixation test with human sera. Early observations suggest that, following infection with one type of poliomyelitis virus, transient complement fixing antibodies to at least two types appear, whereas the longer-lasting neutralizing antibody response is restricted to the virus type causing the infection. (Similar findings have recently been made in human infections with the poliomyelitis fellow-travelers, the Coxsackie viruses.) Mass surveys of normal populations, for neutralizing antibodies to each of the virus types, are in progress to obtain an objective measure of past infection in different communities, and the new information may perhaps allow us to predict epidemics.

Other fields under active investigation include the preparation of tissue culture vaccines free of foreign and dangerous CNS components, and the screening of a multitude of antibiotics and chemical agents for their effect on the multiplication of viruses in human and monkey cultures.

Even this cursory discussion illustrates how important methodology is to the growth of a science, and virology is no exception to this rule. The observation that poliomyelitis virus may be grown in roller tube cultures of human and monkey tissues has been followed by application of the method to clinical, immunological, and epidemiological investigations of the infection. Further work with this relatively simple system should take us far in our understanding of the reactions that occur when virus and host cell meet.

JOSEPH L. MELNICK

Section of Preventive Medicine
Yale University School of Medicine

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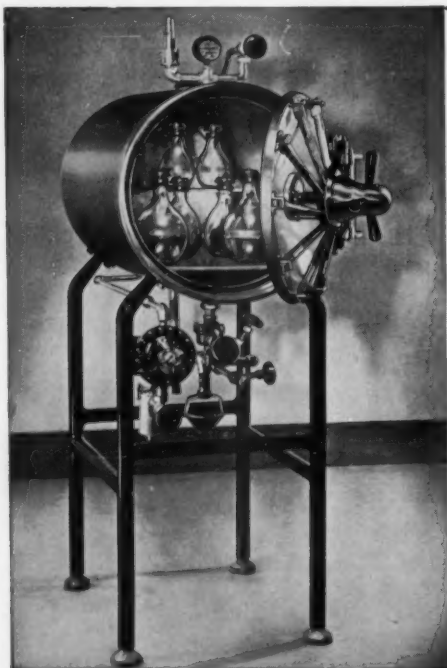
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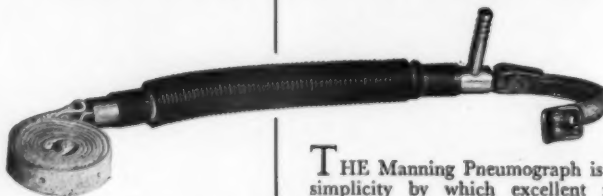
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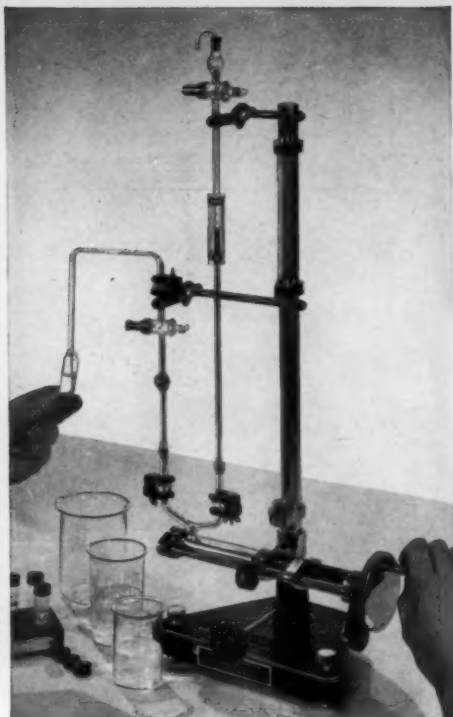
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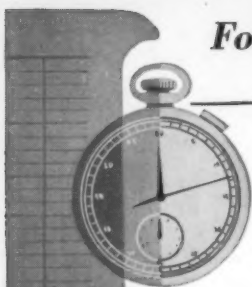
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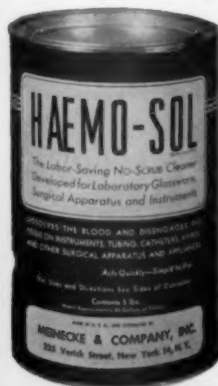
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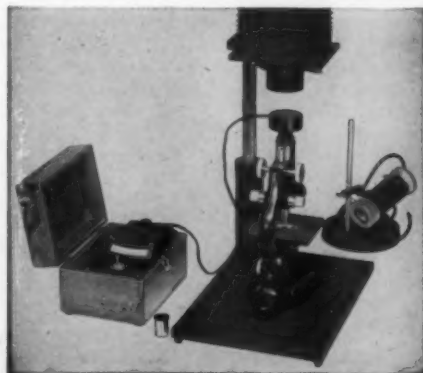
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Science in Ireland

P. J. R. Dempsey

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IT IS A RATHER COMMON BELIEF that the Irish are fonder of fairies than of facts. Nevertheless, in the ardent Celtic temperament we not infrequently find an escapist love of fancy combined with an almost fatalist surrender to facts. Unlike Americans who, accepting reality, immediately begin to think of means to change it, the Irish tend to be fascinated by the order of the world in which they live, and this may, to some extent, account for the fact that their interests lie more in pure than in applied science. Not that applied science does not appeal to them, but for various reasons—predominantly psychological—their inclination intellectually is more to rest in contemplation of an order than in the application of discovery to the dynamic transformation of the circumstances in which they live.

To present even a brief sketch of scientific endeavor in Ireland today is both a difficult and a hazardous undertaking. The contribution of the universities would demand an article in itself, and the limits of space oblige us but to recall that splendid work has been and is being done in many spheres, despite very inadequate financial aid and an overcrowded lecture schedule. American readers are familiar with the name of Walton, a Nobel prize winner of last year, who is professor at Trinity College, Dublin. In this paper we limit ourselves to giving a short account of the Dublin Institute for Advanced Studies, of the work of the Central Statistics Office, and, finally, of medical research.

The Dublin Institute not only sponsors research in Celtic studies, but also possesses a school of theoretical and of cosmic physics. The latter contains two subordinate departments—one on cosmic rays, the other dealing with astronomy. In theoretical physics the senior professors now are E. Schroedinger and J. L. Synge. Walter Heitler, former director of the school, resigned in October 1949 to take up a post in the University of Zurich.

As a result of his lectures in hydrodynamics, Synge has obtained a new and simple condition satisfied by the vorticity and expansion in the plane motion of a viscous fluid in a fixed container. He has also investigated problems connected with the transmission of energy by sonic and electromagnetic waves. Work continues on the method of the hypercircle in function-space for the approximate solution of boundary-value problems. The geometrical basis of the method has been clarified, and arithmetical applications have been made to problems of torsion. In addition, Synge, taking as analogy Hamilton's formulation of geometrical optics, has attempted a relativistic treatment of the two-body problem. Schroedinger has lectured

on the geometry of space-time calculated to lead to a new nonsymmetric unified field theory. Among the problems that arose in the course of these lectures, and that were partly solved by Schroedinger and his associate Symmonds, were those of pseudo-energy tensor in the new theory, special singularity-free-wave solutions, and the general solution for a weak charge-free field of electromagnetic waves. Work by Basu concerning the latest development in quantum mechanics included some special collision problems and the quantization of higher order equations, which led Thirring to an automatic regularization of the commutator function and to finite self-energies. Thirring also succeeded in applying the new formulation of quantum electrodynamics to such problems as pair creation by mesons, Compton scattering, etc.

In the school of cosmic physics directed by L. W. Pollak, a gravimetric survey of Ireland was undertaken. Murphy made measurements at about 260 new stations in central Ireland. It is intended to extend the survey to other parts of the country when Cambridge University will again be able to spare its gravimeter, the only one in these islands. Pollak also continued his investigations of the long-period fluctuations of the frequency of cyclones over the Atlantic and, with P. Nolan, concluded the research into the possibility of seasonal forecasting of the yield and sugar content of sugar beets in Waterford. Tedde and Nolan, investigating the relationship between nuclei and meteorological elements in Dublin, found that there exists a linear relationship between the size of nuclei and humidity, the correlation coefficient being 0.75.

In the cosmic ray section of the school, Professor Jánosy, who has since disappeared behind the Iron Curtain, worked with Mc. Cusker, and with Nevin, of University College, Dublin, on various extensions and refinements of the cascade theory of shower production. These included a new formulation of the fundamental diffusion equation and a study of the lateral spread of air showers. Toward the end of the year 1949-50 Nevin and Mc. Cusker prepared a cloud chamber for an investigation to check the Bhabha-Chakrabarty theory of shower production as applied to the electrons that constitute the soft component of air showers. An apparatus for recording meson decay was constructed by Ritson and used to study the angular distribution of slow mesons. In September 1951 a cosmic ray conference was held in Dublin. Rochester and George, of Britain, lectured on V -particles and properties of M -mesons. The principal Irish speakers were Kelly, now research lecturer in University College, Cork, who discussed heavy nuclei

in primary cosmic radiation and the modes of decay of heavy mesons, and Nevin, whose lecture dealt with wire hexagon counters of large area.

The head of the astronomical section is H. Brück, director of Dunsink Observatory. The chief instruments of the observatory are the solar telescope, and spectroscope, and the 36-inch Schmidt-Baker telescope jointly operated by Harvard, Armagh, and Dunsink observatories. These instruments were used for photometric observation of variable and other stars. Occultations of stars by the moon and sunspots are also observed. Absorption line intensities in the infrared region of stellar spectra were studied by Butler, as well as the spectrum of the variable star Beta Lyrae. Other work included observation of fluctuations of intensity of visible solar radiation on the basis of indirect measurements of the solar constant. At the time of writing, Brück, assisted by Jackson, has used an interferometer to calculate, on the occasion of the Khartoum eclipse, the temperature of the sun's outer atmosphere. Attention was also given to electromagnetic waves and the behavior of light.

The development of statistics in Ireland is as yet practically a matter for the Central Statistics Office, Dublin, although in 1951 a chair of statistics was set up at University College, Cork. The bulk of the statistical and economic data available for the country is collected by the central office, which, in addition to reports on special topics, publishes periodically in monthly *Trade Statistics*, the quarterly *Irish Trade Journal*, the *Statistical Bulletin*, and the annual *Statistical Abstract*. The office is responsible for vital statistics and for the censuses of population, which prior to 1946 were taken at decennial intervals. It has provided a unique series of figures concerning agriculture, area under crops, output, etc., for each year since 1847. It undertakes a complete census of industrial production annually, has carried out the first census of distribution in Europe in 1933, and will resume the inquiry on an annual basis from 1952. Various series of price index numbers are computed, covering retail and wholesale prices, etc. The office also prepares and publishes annually the *Balance of International Payments Statement*. It provides information on unemployment, foreign trade, education, and a variety of other social, economic, and financial matters. It produces the raw material for research and, in addition to the data required for administrative action, to some extent carries out the analyses. The technical staff consists of the director, Dr. Geary, deputy director, Dr. McCarthy, and five statisticians. This intensely active group, in addition to the official work, prepares and publishes original papers on both applied and theoretical subjects.

A final word on recent medical research in Ireland: Owing to the interest of the former Minister for Health, an examination of the tuberculosis problem was begun, with particular reference to clinical, social, and economic analysis of representative samples, study of the progress of disease, extent of infection, of available statistical information, and of most suit-

able methods of case finding, domiciliary care, etc. As regards cortisone, Ireland was one of the first countries to attempt clinical tests with the new drug. With a team of workers, Professor Moore, of University College, Dublin, treated (1949-50) over 35 cases of rheumatoid arthritis, over 100 cases of diseases of the eye, and a number of cases of toxemia of pregnancy. Hingerty, attempting to reach a more complete understanding of the primary metabolic function of cortisone, has investigated the effect of the hormone on the electrolyte permeability of muscle tissue, on certain aspects of carbohydrate metabolism, and on certain inorganic constituents of muscle and plasma. In bacteriology, Bigger, of Trinity College, assisted by Ware and Boggust, examined the action of sulfathiazole on *Bacterium coli* in fluid culture media. Conway, of U.C.D., already known to SCIENCE readers, has continued research on the acid production and electrolyte exchanges in yeast. Cocker, of T.C.D., has continued work on ψ santonin. Barry, Twomey, and Belton have done excellent work on the chemotherapy of tuberculosis. In dermatology F. O. Meenan has continued research on the culture and identification of fungi affecting the skin and its appendages. In gynecology Bradshaw has continued his investigations concerning urinary steroid excretion in normal cases during the last month of pregnancy, labor, and the first days of puerperium. Donovan and Counihan, of University College, Cork, have reported on cardiac murmurs and thrills, and are doing research on cases of chronic cor pulmonale. Kane and Law, of the same institution, have continued work on neuroganglion of circumvallate papillae of the pig's tongue. Kiely is proceeding with research in surgery and hopes to incorporate his findings in the second edition of his work on surgery. E. F. McCarthy, in the Low Temperature Laboratory at U.C.D., is progressing with his study of proteins of plasma and other fluids of biological interest. With E. I. McDougal he is publishing a work on the "Absorption of Immune Globulin in the Newborn Lamb." In his virus laboratory at St. Vincent's Hospital P. N. Meenan continues his research on the etiology of virus pneumonia in Ireland. In the influenza epidemic of 1950, five strains of virus were isolated, and it was shown that the subtypes responsible for influenza all over the world that year were also present in Ireland. The spread of the epidemic, it was noted, appeared to be by continuity of district, rather than by lines of communication.

The problem of the advancement of science in Ireland is to no small extent a financial one—meager and insufficient funds are available. Besides the financial circumstances, certain psychological factors tend to inhibit the full deployment of the energies of those inside (and outside) the scientific field. It is to be hoped that in the near future, with more funds (wherever they may come from) and greater facilities, the nation will be enabled to realize all its potentialities and to make the contribution of which it is capable toward scientific knowledge, its own welfare, and the happiness of mankind.

Androgenesis with Zygogenesis in Gynandromorphic Honeybees (*Apis mellifera* L.)¹

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DISCOVERY OF A STRAIN OF HONEY-BEES in which sex mosaics occur with high frequency in the progeny of some queens presented the opportunity for experimental study of the cytogenetic origin of the component male and female tissues (1). The question of this origin has been discussed from time to time since 1864 (2), but until now no genetical or cytological data have been secured from living specimens. No absolutely controlled matings were possible until the development of artificial insemination of honeybees by Watson (3,4) in 1927, and such control was not completely practical until the more recent improvements of the insemination technique by Laidlaw (5) and by Mackensen and Roberts (6).

Several hypotheses, nevertheless, have been advanced to explain the occurrence of gynandromorphs in bees. After studying the body colors of a few museum specimens of the now-famous Eugster gynandromorphic bees, Boveri (7) concluded that the male parts possessed only traits inherited from the mother, whereas the female parts possessed traits inherited from both parents. He suggested that the egg pronucleus divided once, twice, or more prior to fertilization. One of these cleavage nuclei then united with a sperm pronucleus, and this zygote gave rise by zygogenesis (origin from a zygote) to the female parts of the resulting mosaic. The other cleavage nucleus (or nuclei) did not unite with any sperm but did develop into male tissue by gynogenesis (origin from a female).

Morgan (8), on the other hand, reasoned that the mosaic sex types could be explained if an accessory sperm undergoes cleavage along with the zygote resulting from normal syngamy. It is known that polyspermy normally occurs in fertilization of the bee's egg (9). Male parts, under Morgan's explanation, would possess the genetic characters of the father only (androgenesis—origin from a male). The morphological descriptions of von Englehardt (10) provided possible support for this mechanism (11), but later

developments in *Drosophila* work prompted the following explanation.

After sex-chromosome elimination was found to be important in the production of *Drosophila* mosaics, Morgan and Bridges (11) favored it as the explanation of the honeybee gynandromorphs. A normal diploid individual might lose one sex chromosome from an early cleavage nucleus. Tissue derived from such a deficient nucleus was expected to be male, whereas nondeficient tissue would be female. Whether male parts of a gynandromorph showed paternal, maternal, or biparental characters would depend in this case on sex-linkage or nonsex-linkage of the hereditary traits being followed, and on whether a paternal or maternal chromosome were eliminated. This explanation, possibly, possessed the advantage of reconciling the opposing observations of Boveri and von Englehardt.

Work of P. W. Whiting and Anna R. Whiting in *Habrobracon* sex determination (12, and earlier papers) gave rise to another explanation by Altenburg and Muller (13), which involved dispermic fertilization of a binucleate egg. If one of the zygotes of such an egg contained heterozygous and the other contained homozygous sex factors, female and male tissue, respectively, would be produced in one individual. Both kinds of tissue would be biparental as to the derivation of their genetic constitutions.

Use of our recently discovered stock has permitted tests of the above and other hypotheses as to the origin of honeybee sex mosaics. Experimental matings of three different types were used in these analyses. Resulting data and conclusions were presented in part at the 1951 meeting of the Genetics Society of America (14).

Type I evidence: Use of different marker genes in parents of the mosaic. This involved queens homozygous for the recessive ivory-eye gene (*i*) artificially inseminated with semen from drones hemizygous for the recessive gene for chartreuse eyes (*ch*). Data from several matings established that ivory and chartreuse are nonallelic and nonlinked. Female progeny from these matings were black-eyed (wild type), and male progeny were ivory-eyed. Four samples of progeny from three queens contained 347 living gynandromorphs. Their female eye facets were black, but their male facets were chartreuse. Since neither the ivory nor chartreuse gene appears to be located in any possible sex chromosome, this result provides evidence for the androgenetic origin of the male parts.

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² The data reported here will form part of a thesis to be submitted by Walter C. Rothenbuhler in partial fulfillment of the requirements for the Master of Science degree.

³ Assistance of William L. Downes is gratefully acknowledged.

Type II evidence: Progeny tests of the genetic constitution of the supposed androgenetic tissue. This type of experiment was carried out by using as sperm sources for inseminations gynandromorphs having male reproductive organs. The gynandromorphs were obtained from a mating of a queen homozygous for the recessive ivory-eye gene by drones hemizygous for the recessive cream-eye gene (*cr*). Cream is nonallelic with either ivory or chartreuse (for females from such matings have black eyes) and, on the basis of limited data, is not linked with ivory. There are no data on linkage of cream and chartreuse. Gynandromorphs from the ivory female by cream males mating had mutant male facets, but it was impossible to be sure whether they were cream or ivory because of color similarity of the phenotypes of the two genes. On the basis of results from the Type I experiment, however, the male parts of these gynandromorphs were expected to be cream. To test this, semen produced by seven such gynandromorphs was used to inseminate three cream queens. Samples of brood from the three queens yielded 311 worker progeny. Every worker bee had cream eyes. This establishes that the male parts of the gynandromorphic fathers were cream, and adds further evidence for androgenesis in combination with zygogenesis as the origin of the sex mosaics. Production of worker progeny in numbers establishes that the male parts of these gynandromorphs did produce functional sperms.

Type III evidence: Use of two genetically different kinds of sperms in an insemination. Only one of two such mixed-sperm inseminations will be described here. Both, however, were consistent with the hypothesis of androgenesis. An ivory queen was inseminated with both chartreuse-bearing and ivory-bearing sperms. She produced in two samples 3363 black workers (ivory egg \times chartreuse sperm) to 381 ivory workers (ivory egg \times ivory sperm). This count shows that 89.8 per cent of the functioning sperms are chartreuse and 10.2 per cent are ivory. If an accessory sperm is giving rise to the male parts of gynandromorphs, there ought to be both ivory and chartreuse male parts in various individuals, and each of these should occur in combination with both ivory and black female parts in predictable numbers. Fifty-one gynandromorphs collected from this mating had both male and female eye parts, and were classified as

TABLE 1

Combination	Chartreuse ♂ Black ♀	Chartreuse ♂ Ivory ♀	Ivory ♂ Black ♀	Ivory ♂ Ivory ♀
Expected	41.1	4.7	4.7	0.5
Observed	41.0	4.0	6.0	0.0

shown in Table 1. The class showing chartreuse male parts in combination with ivory female parts constitutes critical evidence. Two genetically different sperms must be involved for this result to be realized in its expected frequency. The results of the mixed-sperm insemination are in accord with results of the first two experiments.

Androgenesis in combination with zygogenesis has been advanced as the preferred explanation for only a few cases of mosaicism prior to this time. Crew and Lamy (15) reported on 49 mosaics in *Drosophila pseudoobscura*. Forty-five of these appeared to have only paternal chromosomes in part of their tissue. One of these mosaics provided evidence resembling our Type III data, one was somewhat like our Type II, and the remainder bore some resemblance to our Type I. In the latter group some individuals were ambiguous (as pointed out by the authors), but others were clear. Polyspermy is normal in *Drosophila*, but Crew and Lamy did not attribute the exceptional tissue, in most cases, to cleavage of an accessory sperm.

Whiting (16) described 13 mosaics in *Habrobracon juglandis*, which were interpreted as having tissue of androgenetic origin. Twelve of these mosaics were equivalent to our Type I individuals, but the other one gave evidence somewhat resembling our Types I and II. Hollander (17) concluded that androgenesis was the probable origin of the exceptional parts in seven mosaics in pigeons (*Columba livia*). To varying degrees six of these individuals resembled our Type III, and one was somewhat like our Types II and III.

That both a sperm nucleus and a fusion nucleus may undergo cleavage in the same egg and subsequently give rise to a mosaic individual appears to be established as a biological phenomenon.

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News and Notes

Indian Science Congress, 39th Session

THE Indian Science Congress opened its 39th session with the recitation of the *Vande Mataram* in the compound of the Presidency College, Calcutta, which also witnessed the birth of this august organization 39 years ago. H. C. Mukerji, Governor of West Bengal, and S. N. Banerji, vice chancellor of Calcutta University and chairman of the Reception Committee, extended a hearty welcome to the distinguished gathering of scientists, and B. C. Roy, chief minister of West Bengal, inaugurated the session. Then Jawaharlal Nehru, Prime Minister of India, delivered his address, in the course of which he called upon scientists of every rank and level to lend him their active cooperation in the solution of the gigantic problems facing the teeming millions of India. Mentioning that the establishment of National Laboratories was a matter of pride for the people of India, he observed that the masses ought to realize the importance of the role that the scientist has to play in the building of a truly modern India.

J. N. Mukherji, director of the Central Building Research Institute, Roorkee, and president-elect of the session, in his presidential address entitled "Science and Our Problems: Science and the Yield per Acre," urged scientists to ask themselves how far they were wielding their influence in the planning and implementation of the reconstruction programs of the newly born Indian Republic. He added that planning was no less imperative for successful scientific research and training than for any other undertaking. Dr. Mukherji disapproved of the pursuit of science with purely academic objectives, in virtual isolation from the wider spheres of industry and agriculture.

The session was attended by nearly 40 notable scientists from the United States, the United Kingdom, Switzerland, Denmark, West Germany, the USSR, Australia, and Japan. Among them were J. B. S. Haldane (UK), biologist; M. Heidelberger (USA), chemist; C. B. Fawcett (UK), geographer; E. C. Bullard (UK), geophysicist; and others.

To facilitate discussion the Indian Science Congress has been divided into 13 sections—Mathematics, Statistics, Botany, Anthropology and Archaeology, Chemistry, Geology and Geography, Medical and Veterinary Sciences, Physics, Engineering and Metallurgy, Physiology, Psychology and Educational Sciences, Agricultural Science, and Zoology and Entomology.

Among the presidential addresses of great interest and popularity were "Some Aspects of Crystal Magnetism" (Physics); "Etiology of Cancer" (Medical and Veterinary Sciences); "Some Recent Methods of Solving Problems of Equilibrium and Vibration" (Mathematics); "Technical Education" (Engineering and Metallurgy); and "Adaptation and Evolution" (delivered by S. L. Hora at the anniversary meeting of the National Institute of Sciences of India).

The most important items on the agenda of the sectional meetings were the reading and discussion of research papers, of which more than 700 were communicated by scholars from every part of the country.

Among the significant symposia mention may be made of the following: "Soil Research in India," organized by the National Institute of Sciences of India and initiated by J. N. Mukherji; "Fermentation Technology" (Chemistry); "Is Evolution Purposeful?" (Botany and Zoology); "Family Types and Changes in the Family of India" (Anthropology and Psychology); "Geography of Crop Plants" (Botany); "Refugee Problem in Bengal" (Anthropology); "River Control" (Engineering and Metallurgy); and "Mathematical Teaching and Research in India" (Mathematics), which was arranged by B. N. Prasad. In view of the timeliness of the subject it has been agreed that the symposium will be continued year after year to arrive at definite conclusions about the ways and means of reforming mathematical teaching and research in India.

"Relation of Biology with other Sciences," by Professor Haldane; "The Ocean Floor," by Professor Bullard; "Antibiotics," by Dr. Kane; "Story of Monazite Sands," by S. S. Bhatnagar; "Fisheries of South East Asia," by Dr. Kesteven; and "Defence Science and its Organization," by Dr. Kothari, were some of the popular lectures delivered.

One of the most instructive features of the session was the Science Exhibition, to which exhibits from various scientific firms were contributed. Another interesting feature was the arrangement for scientific excursions to the Tata Iron and Steel Works and the National Metallurgical Laboratory of Jamshedpur, Chittaranjan Locomotive Works, Damodar Valley Project, Mayurakshi Reservoir Project, and Indian Institute of Technology, Kharagpur.

To synchronize with the annual session of the Indian Science Congress, a large number of scientific associations and societies, such as the National Institute of Sciences of India, Indian Physical Society, Indian Chemical Society, and many others, held their annual meetings. Also, the Geological, Mining and Metallurgical Society of India celebrated its Silver Jubilee this year.

At the general meeting of the Science Congress D. M. Bose, director, Bose Research Institute of Calcutta, was elected president of its 40th session, which will be held at Lucknow in January 1953. B. N. Prasad, of Allahabad University, and S. R. Sen-Gupta, of Bengal Engineering College, Shibpur, were elected general secretaries, and P. C. Mahalanobis was elected treasurer.

B. N. PRASAD
(General Secretary, Indian Science
Congress Association)

Mathematics Department
University of Allahabad

Scientists in the News

John E. Allen, acting head of the Department of Geology of the New Mexico Institute of Mining and Technology, has joined the research staff of the New Mexico Bureau of Mines and Mineral Resources. **Charles R. Holmes**, of the Research and Development Division of the institute, will resume his investigations on underground water this summer after having spent a year as instructor in geophysics.

Allen V. Astin has been named director of the National Bureau of Standards. He has been acting chief of the bureau since last October, shortly after the resignation of **Edward U. Condon**, AAAS president-elect. Dr. Astin, who has received recognition for his contribution to the development of the proximity fuse, joined the Bureau of Standards in 1932. Until 1940, he was active in electronic research and did pioneer work in radio telemeter techniques for exploring the earth's upper atmosphere. In 1940 he was assigned to the newly formed proximity fuse research group in the bureau and took a leading part in development of the fuse. After the war Dr. Astin became assistant director of the bureau's ordnance department and in 1947 became chief of that division. In 1950 he was appointed associate director of the bureau, had charge of ordnance and missile development, and coordinated the bureau's technical work with other government agencies.

Ernest F. Bean, state geologist of Wisconsin, is retiring after 35 years of service on the State Geological Survey. Also retiring from the University of Wisconsin faculty is **J. H. Mathews**, chairman of the Department of Chemistry. Dr. Mathews started his teaching career at Wisconsin in 1908, seven years before Dr. Bean.

Among the members of the Lehigh University faculty who will be retired June 30 are **Jacob L. Beaver**, professor of electrical engineering; **Arthur W. Klein**, professor of mechanical engineering; and **Kenneth W. Lamson**, associate professor of mathematics.

On July 1 **Vernon I. Cheadle**, at present head of the Department of Botany and director of graduate studies at the University of Rhode Island, will assume his new duties at the University of California, Davis, as professor of botany, chairman of the Division of Botany, and botanist of the Experimental Station.

The Atomic Energy Commission has established an Office of Industrial Development, headed by **William Lee Davidson**, former director of physical research for the B. F. Goodrich Company, for the distribution of technical atomic information "of primary importance" to industry "in the fields of chemistry, metallurgy, specialized equipment, and power generation."

C. E. Nabuco de Araujo, Jr., has been elected to

the Board of Directors of the Standard Oil Company of Brazil and assumed his new obligations on May 1.

The Katherine Berkan Judd prize for the greatest advancement made during 1951 toward the discovery of a cure for cancer was awarded posthumously to **Konrad Dobriner**, former chief of the division of steroid metabolism at the Sloan-Kettering Institute for Cancer Research. Dr. Dobriner died on March 10.

The 1952 medal of the American Cancer Society for "important contributions to the control of cancer" has been presented to **Mrs. Edward F. Hutton**, a founder of the woman's division of the New York City Cancer Committee, a division of the American Cancer Society. Certificates of award also were presented to 38 scientists who are receiving grants for cancer research this year.

Earl D. Johnson, assistant secretary of the Army in charge of procurement and research and development programs, has been designated as the civilian Army member of the Research and Development Board. Mr. Johnson succeeds **Archibald S. Alexander**, who recently resigned as under secretary.

Jorgen Koch, of the Institute of Theoretical Physics at Copenhagen; **Nicholas Van Kampen**, of the University of Leiden; and **Raymond Coutrez**, physicist, Observatoire Royal de Belgique at Brussels, were recent visitors at the National Bureau of Standards.

The H. C. Hachmeister Lecture in Pharmacology for 1952 was delivered by **George B. Koelle** on the subject "Pharmacological and Therapeutic Significance of Anticholinesterase Drugs." Dr. Koelle was selected for the lectureship for his pioneer studies on anticholinesterase drugs and for developing a histochemical method for localizing cholinesterase activity. Now with Columbia University College of Physicians and Surgeons, Dr. Koelle has just been appointed professor of pharmacology in the University of Pennsylvania Graduate School of Medicine.

Bernhard Kummel has been appointed associate professor of geology at Harvard University effective July 1. Dr. Kummel has been a member of the faculty of the University of Illinois since 1948.

Robert W. McLaughlin, Jr., of the firm of Holden, McLaughlin & Associates, New York, has been appointed director of the School of Architecture at Princeton University. Mr. McLaughlin will assume his new duties next fall while continuing the practice of architecture. He succeeds **Sherley W. Morgan**, who has been associated with the school since its establishment in 1920 and director since 1928.

President Truman has designated **Mark A. May**, Yale University professor, as chairman of the United States Advisory Commission on Information. The commission advises the Department of State on its informational programs, including the Voice of

America. Dr. May has been professor of educational psychology and director of the Institute of Human Relations at Yale. He has been on the Advisory Commission since it was set up under the Information and Educational Exchange act of 1948. As chairman he succeeds **Erwin D. Canham**, editor of the *Christian Science Monitor*.

T. S. Motzkin, of Hebrew University and the National Bureau of Standards, has been appointed to a visiting professorship at the University of California, Los Angeles.

Carleton C. Murdock will retire June 30 as dean of the university faculty and professor of physics at Cornell University. He has been a member of the Cornell teaching staff since 1909 and faculty dean since 1945.

Erwin E. Nelson has resigned as medical director of the Food and Drug Administration of the Federal Security Agency, to become professor and director of the Department of Pharmacology of St. Louis University School of Medicine.

Elburt F. Osborn has been named associate dean of the School of Mineral Industries at the Pennsylvania State College. He will continue to serve as professor of geochemistry and head of the Department of Earth Sciences.

At the regular meeting of the Paleontological Research Institution, Ithaca, N. Y., on Apr. 5, **Katherine V. W. Palmer**, of Ithaca, was elected director of the institution.

Dean W. Roberts has been appointed director of the Commission on Chronic Illness. Dr. Roberts is now deputy director of the Maryland State Department of Health. He will succeed **Morton L. Levin**, New York State Department of Health, who received a leave of absence in 1950 to direct the work of the commission in its early stages. Dr. Roberts will assume his new duties on July 1.

Dwight L. Ryerson, associate professor of zoology at Pomona College, has been awarded a Scripps Research Fellowship at the Biological Research Institute of the San Diego Zoological Society for study June 1952–February 1953. The research project is in the field of comparative hematology and will involve the characterization of blood samples taken from a variety of animals available at the zoo.

J. R. Schramm, chairman of the Department of Botany and director of the Morris Arboretum of the University of Pennsylvania, has been awarded the Franklin Medal of the American Philosophical Society. This medal, designed by St. Gaudens, was struck in commemoration of the bicentenary of Benjamin Franklin, founder and first president of the society.

Paul C. Silva, of the University of California, has

been appointed instructor in botany in the Department of Botany, University of Illinois, beginning Sept. 1. He will offer courses and develop a research program in phycology. **Natalie Harlan Davis**, of New York, has been appointed scientific artist in the department.

C. Guy Suits has been appointed a civilian member of the Committee on Electronics of the Department of Defense Research and Development Board. Dr. Suits, who is vice president and director of research for General Electric Company, was formerly a member of the RDB Committee on Ordnance, and is at present a member of the Special Technical Advisory Group of the board and the Joint Chiefs of Staff. Civilian members in addition to **D. A. Quarles**, vice president of Western Electric Company and president of the Sandia Corporation, and Dr. Suits are **E. W. Engstrom**, research director, RCA Laboratories, and **William L. Everitt**, dean of engineering at the University of Illinois.

Gordon N. Thayer has been made a vice president of Bell Telephone Laboratories with responsibility for its military development program and relationships with the Army, Navy, and Air Force. He succeeds **Timothy E. Shea**, who is resigning to accept the office of vice president of Sandia Corporation at Albuquerque, N. M., the Western Electric-Bell Laboratories-operated organization developing military applications of atomic energy for the Atomic Energy Commission. **M. B. McDavitt** replaces Mr. Thayer as director of transmission development, and **A. J. Busch** succeeds Mr. McDavitt as director of switching development.

The resignation of **Shields Warren** as director of the U. S. Atomic Energy Commission's Division of Biology and Medicine and the appointment of **John C. Bugher** as his successor have been announced. Dr. Warren will become a member of the AEC's Advisory Committee for Biology and Medicine. Dr. Bugher, deputy director of the Biology and Medicine Division since 1951, has been a member of the International Health Division of the Rockefeller Foundation since 1938. During his association with AEC, Dr. Warren continued his service as pathologist at the New England Deaconess Hospital in Boston on a part-time basis. He will resume full-time duties there after June 30.

Alfred Weissler, of Washington, D. C., has been appointed chief of the Chemistry Branch, Chemical Sciences Division, Office of Ordnance Research. Dr. Weissler has been staff scientist in the Research and Development Division, Office of Chief of Ordnance, Department of the Army. For the past six years he has also served as an assistant professor of chemistry at the Graduate School, University of Maryland.

James A. Welch, of the University of Illinois, has been appointed assistant professor and assistant animal husbandman at West Virginia University.

Education

The Geophysical Institute of the University of Alaska is holding regular colloquia twice monthly, usually on the first and third Wednesdays. Members of the staff and visiting scientists will participate in discussions of the aurora, the ionosphere, and backscatter. On Aug. 20 and 27 there will be a preview of the papers to be given at the third Alaskan Science Conference. Walter I. Flood, Jr., of Cornell, will lecture at least twice during July and August, and during September Sydney Chapman, of Queen's College, Oxford, will give a series of lectures on "Theories of Magnetic Storms and Aurora." Because of the Chapman lectures and the science conference, there will be no regular colloquia during September.

The Division of Biological Sciences of the University of Michigan will present its third Summer Biological Symposium, dealing with "Biological Regulations," July 7-18. Speakers will include Jack Myers, Frank H. Johnson, Carroll M. Williams, and Dwight J. Ingle. There is no registration fee, and visiting scientists are invited. Further information concerning the program may be obtained from Ursula R. Freimarek, 2092 Natural Science Bldg., Ann Arbor.

Weizmann Institute, Israel, has recently added a Department of Experimental Biology, headed by Isaac Berenblum, formerly of Oxford University. Associated with him is M. C. Shelesnyak, whose interest is in reproductive physiology. New activities contemplated include a section that will deal with cell genetics, a laboratory devoted to enzymology of abnormal tissues, and the study of the biochemistry of cell particulates. A new biological building is being erected to provide laboratories for an enlarged staff, space for students and visitors, and animal quarters.

In the Laboratories

Robert Austin, of Consolidated Engineering Corporation, has joined Beckman Instruments as a specialist in the development of titration instruments.

A new center for fresh-water fisheries research, to be known as the Rocky Mountain Fishery Investigations, has been opened by the Fish and Wildlife Service in the Forestry Building of the Utah State Agricultural College at Logan. The staff is headed by Oliver B. Cope. Chief interest will be in the fishery of Yellowstone Lake, where field work has been carried on for the past two summers. Fresh-water problems in other public lands in the area will probably fall within the purview of the new organization.

Shell Chemical Corporation has concluded negotiations for the purchase of Julius Hyman & Company and has made an agreement with Velsicol Corporation for exclusive rights to aldrin and dieldrin, agricultural insecticides. The Hyman Company will continue to be operated under its present name, as a wholly owned subsidiary of Shell, and most of the present operating and technical personnel will be retained.

Meetings and Elections

The third Alaskan Science Conference and the annual meeting of the Alaska Division of the AAAS will be held Sept. 22-28 at Mount McKinley Park Hotel. C. T. Elvey, director of the Geophysical Institute, University of Alaska, will be chairman of the Geophysics Section, which will have sessions on the physics of the aurora, radio propagation, meteorology, and other topics. Further information may be obtained from Dr. Elvey or by writing to the secretary, Alaska Division, Box 960, Anchorage.

The following officers have been elected by the American Neurological Association: president, Hans H. Reese; president-elect, Roland P. Mackay; vice presidents, Thomas K. Davis and James C. White; secretary-treasurer, H. Houston Merritt; assistant secretary, Charles Rupp.

A Conference on Magnetism, sponsored by the Office of Naval Research, will be held at the University of Maryland Sept. 2-6. Foreign visitors expected to attend and present papers include Louis Neel, E. C. Stoner, L. F. Bates, W. Sucksmith, and C. J. Gorter. V. Wilson, General Electric Research Laboratory, Schenectady, N. Y., is in charge of schedules for visits to laboratories and universities for the foreign participants, and G. T. Rado, Naval Research Laboratory, Washington, D. C., is chairman of the program committee.

Newly elected officers of the Society of Economic Paleontologists and Mineralogists are: president, Clifford C. Church; vice president, Morton B. Stephenson; secretary-treasurer, Cecil G. Lalicker (re-elected.)

West Virginia Academy of Science elected the following officers at its annual meeting in Buckhannon: president, B. G. Anderson; vice president, E. E. Myers; secretary, James T. Handlan, Jr.; treasurer, James L. Hall.

Miscellaneous

The American Society of Biological Chemists has awarded funds for travel to the second International Congress of Biochemistry, which meets in Paris July 21-27, to: G. W. Plaut, University of Wisconsin; Warwick Sakami, Western Reserve University, and E. R. Stadtman, National Heart Institute.

The imperative need of integrating science is reflected in the rapidly increasing number of associations for the advancement of science. Most recent additions to the list are organizations functioning under this name in Venezuela and Ecuador and, in the Eastern Hemisphere, in Ceylon, Burma, and the Philippines. Unesco, through its Natural Sciences Department, is sponsoring a coordinating committee of associations to maintain contacts and to arrange regional meetings that should minimize tendencies on the part of any such organization to develop too provincial an outlook.

The Association of University Women has awarded 33 fellowships, totaling \$58,700, for the coming academic year. Twenty-three of the annual awards went to U. S. citizens, one to a Peruvian, and the others to women in Switzerland, South Africa, Canada, Austria, Norway, Sweden, and England. Stipends range from \$1500 to \$3000 and will support work in both science and the humanities.

Meeting on Oct. 18, in Rio de Janeiro, delegates from 12 nations founded a new world medical society to be known as the **International Fertility Association**. The first World Congress on Fertility and Sterility sponsored by the new society will be held in conjunction with the meeting of the American Society for the Study of Sterility in New York City next May. For further information address Carlos D. Guerrero, Secretary-General, Miguel E. Schulz, 10, Mexico, D. F., or Abner I. Weisman, Associate Secretary-General, 1160 Fifth Ave., New York City.

Recent Deaths

Edward H. Berger (59), industrial chemist, Roseland, N. J., May 12; Howard W. Blakeslee (72), science editor, Associated Press, Port Washington, N. Y., May 2; Frederick S. Breed (75), educator, Chicago, May 16; George L. Brodhead (83), obstetrician, New York, May 13; A. Rex Burnette (64), of New York, consulting engineer, Camaguey, Cuba, May 2; Thomas F. Burns (60), pediatrician, Fall River, Mass., Apr. 24; Eugene A. Case (74), pathologist, Philadelphia, Apr. 20; Guido Castelnovo (87), mathematician, Rome, Apr. 27; Archibald Church (91), neurologist, Pasadena, May 8; Charles G. Cole (80), educator, South Orange, N. J., May 16; Allston Dana (67), design engineer, Harrisburg, Pa., May 12; Marguerite T. Dean (61), dentist, Hernando, Miss., Apr. 21; Everett E. Edwards (52), agricultural editor, Bethesda, Md., May 1; James H. Edwards (74), economist, Fort Lauderdale, Fla., May 18; John B. Ekeley (81), chemist, Boulder, Colo., Apr. —.

Heman C. Fogg (57), chemist, Dover, N. H., May 5; Alger C. Gildersleeve (83), civil engineer, New York, May 3; Samuel G. Gordon (54), mineralogist, Cincinnati, May 17; Russell L. Haden (63), medical director, Red Cross national blood program, Cleveland, Apr. 26; Hugh E. Hale (78), civil engineer, New York, Apr. 30; Robert L. Hallett (70), mining engineer, New York, May 17; Virginius B. Hirst (61), otolaryngologist, New York, May 9; Edward Hoenig (70), gynecologist, New York, May 3; Percy Hughes (80), of Belvidere, N. J., psychologist, Clinton, N. J., Apr. 22; Clark L. Hull (67), psychologist, New Haven, Conn., May 10; Leonard Johnstone (—), wireless pioneer, Wilnot Station, N. S., May 6; Carleton P. Jones (71), chemist, Amherst, Mass., May 16; Frederick A. Jostes (56), orthopedic surgeon, St. Louis, May 19.

Frank A. S. Kautz (76), obstetrician, Cincinnati, May 12; George W. Knight (74), chemist, Philadelphia, May 14; H. A. Kramers (57), physicist, Leyden,

Netherlands, Apr. 24; Karl Krug (79), electrical engineer, Moscow, Apr. 26; Henry A. Laessle (80), otolaryngologist, Philadelphia, May 13; Arthur B. Lamb (72), chemist, Cambridge, Mass., May 15; Jorge A. Lleras (68), electrical engineer, author, and astronomer, Bogota, Colombia, Apr. 20; Wm. F. Lynch (71), surgeon, Worcester, Mass., May 2; G. W. McCoy (75), epidemiologist, Washington, D. C., Apr. 2; Charles E. MacQuigg (67), engineer, Columbus, Apr. 24; Nikolai Maksimov (73), plant physiologist, Moscow, May 9; Arthur B. Meservey (67), physicist, Hanover, N. H., May 8; Ernest B. Mongel (76), eye specialist, Philadelphia, May 12; Maria Montessori (81), educator, Noordwijk, Netherlands, May 6; Joseph W. Mountin (61), public health authority, Washington, D. C., Apr. 26.

Morris H. Nathanson (59), physician and educator, Los Angeles, Apr. 24; Aven Nelson (93), botanist and educator, Colorado Springs, Mar. 31; Joseph S. Newell (54), aeronautical engineer, Boston, May 5; Albert B. Newman (64), chemical engineer, New York, May 9; Charles W. Norton (62), research engineer, Lakeville, Mass., May 3; Thomas Ordway (75), pathologist, Albany, N. Y., May 12; Benjamin O'Shea (75), former president, Union Carbide & Carbon Corporation, Lester Manor, Va., May 2; Edward C. Phillips (74), astronomer, St. Andrew-on-Hudson, N. Y., May 9; John B. Price (69), otorhinolaryngologist, Norristown, Pa., May 11; Paul H. Ringer (70), specialist on pulmonary diseases, New York, May 8; Alan M. Rodgers (62), engineer, Albany, N. Y., Apr. 22; Pavel Romanov (56), specialist on light industry and leather processing, Moscow, Apr. 26.

Benedict Saurino (47), statistician, Philadelphia, May 9; Traugott Schuck (68), obstetrician and surgeon, Hoboken, N. J., May 15; Ellwood D. Schuster (84), civil and mining engineer, Franklin, N. J., Apr. 29; John S. Shaw (67), of Wilmington, Del., safety engineer, Houston, Tex., Apr. 26; Ernest G. Sloman (57), dentist and oral surgeon, Madera, Calif., Apr. 30; Elmore G. Smith (51), logistics expert, Formosa, Mar. 13; P. G. Spillsbury (65), consulting engineer, Washington, D. C., May 3; Arthur Staples (83), educator, Wrightsville Beach, N. C., May 1; Julius W. Sturmer (82), pharmaceutical chemist, Collingswood, N. J., May 4.

Rollin H. Tanner (77), educator, Thomaston, Me., Apr. 23; Eugene Theimer (—), of East Orange, N. J., research chemist, Hoboken, N. J., May 5; Harry G. Thomas (82), of Pawling, N. Y., physician, New York, May 6; Thomas G. Tickle (61), otologist, New York, Apr. 26; C. Laurence Warwick (63), civil engineer, Philadelphia, Apr. 23; George B. Waterhouse (69), metallurgist, Cambridge, Mass., May 10; James Watson (64), psychiatrist, Cleveland, Apr. 27; Lucius A. Whipple (65), educator, Greenville, R. I., Apr. 20; John J. White (69), industrialist, Greenwich, Conn., May 15; Louis Wirth (54), of Chicago, sociologist, Buffalo, N. Y., May 3; Fannie H. Yarow (65), obstetrician and gynecologist, New York, May 9.

Technical Papers

Preprotection of Mice against X-Irradiation Mortality by Sodium Nitrite¹

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It is generally recognized that ionizing radiations elicit the formation of highly reactive oxidants (considered to be OH and O₂H radicals, and H₂O₂) in aqueous media containing dissolved oxygen (1-3). There are indeed reasons to believe that many of the observed biological effects of ionizing radiations are a consequence of the chemical reactivity of these oxidants. The studies of Barron *et al.* (4, 5) have shown that moderate doses of x-rays can inactivate certain cellular enzyme systems by virtue of oxidation of essential sulfhydryl groups in these enzymes. The demonstration by Dowdy and his co-workers (6) of the protective effect of anoxic anoxia against lethal doses of x-rays in rats constitutes additional evidence for the role of radiochemical reactions involving oxidants in irradiation injury. Hypoxia secondary to methemoglobinemia has been invoked as a possible explanation for the protection afforded by *p*-aminopropiophenone against 800 r in CF₁ mice (7). One may interpret also the radiation protection afforded by preirradiation administration of cysteine (8) and glutathione (9) as being due to the reducing (i.e., anti-oxidant) properties of these compounds rather than to the presence of sulfhydryl groups *per se*. In a series of experiments designed to screen a number of possible protective agents, sodium nitrite, a reducing agent which can also elicit methemoglobinemia, was reported to be ineffective when administered prior to irradiation of mice with 800 r (10).

In the course of studies on the modification of radiosensitivity in animals, based on considerations to be discussed later, a protective effect against x-ray-induced mortality of mice was observed when sodium nitrite (NaNO₂) was administered prior to x-irradiation. The present preliminary report describes the results obtained.

LAf₁ mice of both sexes, approximately 6 weeks old, and weighing 20-25 g, were used throughout. The animals were allowed free access to food (Purina laboratory chow) and to tap water at all times. Control and experimental animals were irradiated simultaneously, caged together in groups of 5 each, and otherwise treated similarly. In all experiments the

control and experimental groups were matched with respect to age, sex, and body weight.

The irradiation source was a Westinghouse Therapy Unit. The radiation factors were 250 kvp; 15 ma; 0.5 mm Cu plus 1-mm Al filter; HVL, 1.5 mm Cu; target-to-skin distance, 100 cm; dosage rate, 25 r/min, as measured with a Victoreen r-meter placed in air at the position of the mice. Each radiation dose was delivered in a single exposure. During irradiation the mice were contained in individual, perforated lusteroid centrifuge tubes, placed radially on a circular wooden turntable platform rotated at 3.5 rpm to assure uniformity of radiation dosage.

Sodium nitrite (CP) was dissolved in M/15 phosphate buffer pH 7.2 to a final concentration of 5 mg NaNO₂/ml. Either 0.5 or 0.25 ml of this solution was administered intraperitoneally approximately ½ hr before irradiation. The control irradiated groups received equivalent amounts of phosphate buffer. Daily weight changes and survival up to 30 days post-irradiation were used as criteria for evaluation of protective effect.

A summary of the results of the three separate experiments is presented in Table 1. The data reveal that preirradiation administration of NaNO₂ reduces markedly the mortality of mice resulting from a single-dose whole-body irradiation. Of the control group of 19 mice exposed to 600 r in Expt. I, 84% were dead at the conclusion of the 30-day period, whereas none of the 16 nitrite-treated animals, receiving 100-125 mg NaNO₂/kg body weight, were dead. Definite, but less marked, protection was obtained also in the experimental group which had received 1.25 mg NaNO₂ (equivalent to 62 mg/kg). In Expt. III, 100% of the control group of mice exposed to 750 r were dead at 30 days, whereas only 22% of the nitrite-treated group (2.5 mg NaNO₂/mouse) had succumbed. These differences are statistically highly significant.

The weight curves represent averages of daily individual body weights expressed as percentages of preradiation weight. It is apparent from Fig. 1 that the NaNO₂-treated animals receiving 600 r whole-body x-irradiation exhibited a maximum weight loss of only 7% by the seventh day postirradiation, after which a steady increase in body weight was observed, whereas the control group showed a precipitous weight loss starting approximately 8 days post-irradiation, and continuing to a maximum weight loss of 25% on the fourteenth day. Mortality was heaviest during this period. A similar differential in weight loss between the NaNO₂-treated experimental group and the control group, all receiving 750 r, is shown in Fig. 2.

The previously observed failure of sodium nitrite to protect against irradiation (10) may be ascribed to differences in the strain of mice used or, more

¹ This work was supported, in part, by funds provided by the Bureau of Medicine and Surgery of the Navy Department. The opinions and assertions contained in this report are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large (Article 1252, U. S. Navy Regulations, 1948).

² With the technical assistance of M. Ellis.

TABLE 1
EFFECT OF PRETREATMENT WITH SODIUM NITRITE ON MORTALITY OF MICE
AFTER TOTAL-BODY X-IRRADIATION

Expt. No.	No. mice	Treatment	X-ray dosage (r)	Survival at 30 days postirradiation		P
				Number	Percentage	
I	16	2.5 Mg NaNO ₂	600	16	100	< 0.000001
	19	Phosphate buffer	600	3	16	
	6	2.5 Mg NaNO ₂	None	5*	83	
I	18	1.25 Mg NaNO ₂	600	9	50	0.03
	18	Phosphate buffer	600	3	17	
II	18	2.5 Mg NaNO ₂	600	17	94.5	< 0.000001
	20	Phosphate buffer	600	5	25	
	5	2.5 Mg NaNO ₂	None	5	100	
III	9	2.5 Mg NaNO ₂	750	7	78	< 0.001
	10	Phosphate buffer	750	0	0	

* One animal died 30 min after injection.

likely, to the large dose of irradiation employed. The dose of 800 r used by these workers, expressed as percentage of the LD₅₀ under the conditions employed, appears to exceed the dose limit at which protection is observed.

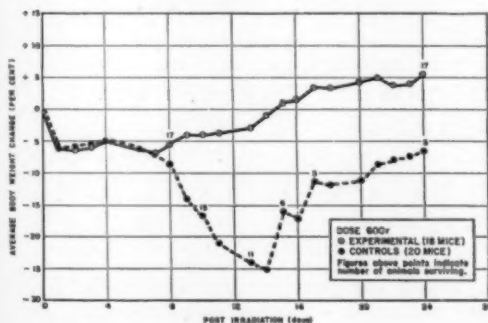


FIG. 1. Effect of sodium nitrite pretreatment on body weight of mice exposed to 600 r.

Feinstein *et al.* (11) have presented experimental data which indicate that the activity of mouse liver catalase is decreased after intraperitoneal injection of H₂O₂ and after whole-body x-irradiation. They concluded that "H₂O₂ may play a significant role in radiation toxicity." Although the role of the enzyme catalase as a limiting factor in protection against radiation injury in mammals has not been established conclusively, an attempt to account for the action of NaNO₂ in modifying the radiosensitivity of mice leads to some interesting speculations when viewed in the light of the results of Chance's studies on catalase kinetics. Chance (12) has shown that the reaction of catalase with H₂O₂ involves first the formation of a catalase-H₂O₂ complex. Once formed, however, this complex does not decompose spontaneously under ordinary circumstances but is relatively stable unless collision and reaction with a donor molecule occur. It is of the greatest interest, so far as the present data

are concerned, that the decomposition of the catalase-H₂O₂ complex is greatly accelerated by sodium nitrite, ethanol, methanol, or sodium formate (13, 14). Chance's detailed investigations clearly indicate that a second order reaction occurs between the catalase-H₂O₂ complex and a donor molecule, resulting in the coupled oxidation of the donor. In addition, the catalases specifically bring about the oxidation of primary and secondary alcohols and related structures. It is of interest to note here (as has Chance) that the structure of nitrous acid resembles that of a secondary alcohol.

If one assumed, then, that catalase activity leading to the destruction of H₂O₂ (and possibly of organic peroxides) is a limiting factor in radiation injury in the mammal, it seems not unreasonable to anticipate that an accelerated decomposition of H₂O₂, in the presence of an excess of suitable donors, would lead to protection against the effects of ionizing radiation. It is proposed, therefore, that a mechanism such as this may be involved in the protective effect against x-irradiation here observed with NaNO₂ pretreatment of mice. That this hypothesis may be valid is suggested by recent experimental data reported by Hol-laender *et al.* (15), who have found that the lethal

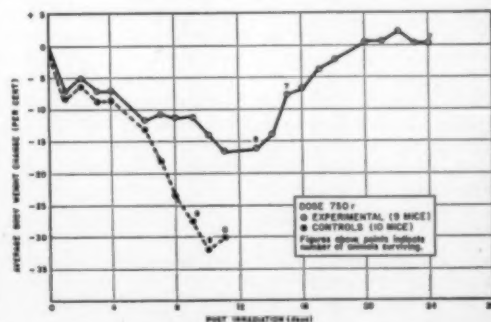


FIG. 2. Effect of sodium nitrite pretreatment on body weight of mice exposed to 750 r.

effect of x-rays on bacterial cells was reduced significantly by sodium formate, ethanol, and glycols. On the basis of the present discussion, these compounds would be expected to accelerate the decomposition of H_2O_2 by catalase and thus prevent the accumulation of deleterious concentrations of this oxidant.

The possibility that the radiation protection afforded by sodium nitrite may be mediated through methemoglobin formation is not excluded. This explanation is open to question, however, since the degree of methemoglobinemia induced by the doses of sodium nitrite used by Rust *et al.* (10) (100 mg/kg), which failed to protect, was comparable to that produced by doses of *p*-aminopropiophenone which afforded definite protection (7). Studies directed toward the elucidation of this question are in progress.

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Manuscript received December 31, 1951.

A Simple Stage-mounted Micromanipulator

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Transplanting inclusions of a few cubic microns volume between living cells is one of the primary objectives of this laboratory. In planning procedures for making such transfers it became apparent that a micromanipulator having the following characteristics was essential:

- 1) Control in three dimensions to a tolerance of about 1μ .
- 2) A range of 0.4 mm in each dimension, movement being essentially rectilinear.
- 3) Syringe intake and output with a volume control tolerance of 1×10^{-12} ml.
- 4) Operation under oil immersion with phase contrast objectives.

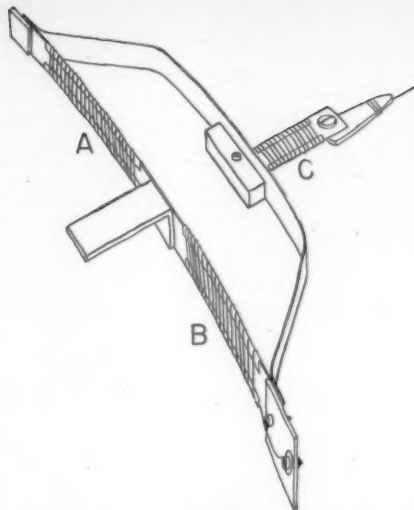


FIG. 1.

The principle utilized in the design of this instrument is that of differential thermal expansion using electrically heated bimetallic elements as motion sources. The foregoing principle has not previously been employed in micromanipulative equipment according to the literature available to us. For its designed function this model has certain advantages over the pneumatic or strictly mechanical manipulators. The primary advantage enjoyed by this manipulator is its small dimensions, which permit it to be mounted on the stage of the microscope. Remote control is effected electrically.

Hypodermic action is obtained by electrically heating a hollow glass needle whose effective volume change depends upon the internal volume of the needle used, the coefficient of expansion of the filling liquid, the operating temperature range of the heater, and the portion of the total volume heated.

Construction of an appropriate needle requires some practice but becomes a simple procedure. The needles used in our study are made from Pyrex glass tubing, and are 2-3 cm in length, with one end closed and the other end drawn out to an internal diameter of approximately 1μ . The walls are relatively thin, giving a total external diameter of approximately 2μ . The needle is completely filled with freshly distilled water, which has very little dissolved gas in it. The low dissolved gas component prevents separation of gas bubbles from the liquid with which the needle is filled. Such gas bubbles give a "mushy" effect in volume control. When heat is applied to the needle, the liquid expands and ejects a proportional part of its volume; the reverse occurs upon cooling. On occasion, volume control has been stable down to approximately $1 \mu^3$ (1×10^{-12} ml).

The organisms being used in our experiments are extremely thermosensitive, yet the heat produced by this

apparatus has never been a source of difficulty. If unshielded, the entire apparatus operates best in a relatively constant air-flow.

In principle, the operation of the "bow" portion of the micromanipulator (Fig. 1)¹ is as follows: There are two heaters on sides *A* and *B*, respectively. These heating coils are wrapped around a continuous bimetallic element. When sides *A* and *B* are heated simultaneously from a reference temperature, they go forward equally and have the effect of ramming the needle forward. If power be decreased on both sides, the cooling which follows permits the bimetallic element to bend back and withdraw the needle from its forward position. If side *A* be heated while side *B* is cooling, the sides will bend forward and backward, respectively, thus producing lateral motion in the direction of side *B*. The converse produces lateral motion in the opposite direction. Attached to the bow is a second bimetallic element (*C*) placed so that its plane is parallel to the stage of the microscope. When this element is heated it bends downward and when permitted to cool it bends upward. This direction of bending is a safety factor to prevent breaking the needle in case power should accidentally be cut off.

The entire apparatus is mounted on a Bakelite block, which is in turn provided with a vertical motion screw, and is hinged at the front end. Counter-sunk into this piece of Bakelite are two Alnico magnets, which hold the entire apparatus steady on a small steel plate mounted on the microscope stage (Fig. 2).² In operation, the apparatus is moved by

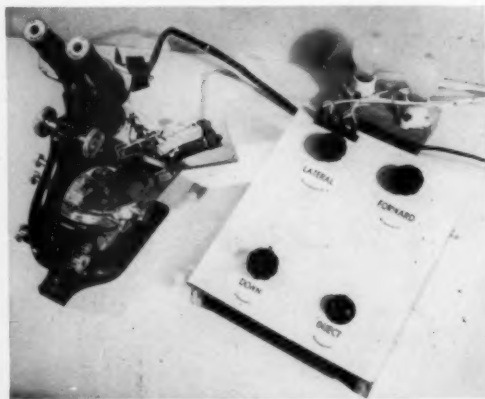


FIG. 2.

hand so that the needle tip comes into view in the microscopic field, then control is taken over electrically for micromanipulative procedures. Such manual control of gross motion has been found entirely adequate for our purposes. The apparatus has two main features in its favor: (1) Since the small steel plate

¹ The magnet-attached bow-base was designed and fabricated by Bailey Moore of this institution.

² Manufacture of this very simple, cheap micromanipulator is planned by the American Optical Company.

is attached directly to the microscope stage, no heavy additional stand is needed. (2) The entire apparatus is very close to its work and is remarkably free from vibration.

The period of movement from one side of the field to the other (under 1.25 N.A. oil immersion) is approximately 12 sec. The control, being electrical, is subject to additional refinement, such as a "joystick," or any number of modifications that the individual might wish to insert.

Manuscript received December 31, 1951.

Comparative Histological Studies of Endocrine Glands of Yellow (*A^ya*) and Non-agouti (*aa*) Mice in Relation to the Problem of Hereditary Obesity¹

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Department of Zoology, University of Texas, Austin

Yellow mice (*A^ya*) show a hereditary tendency to become obese. The yellow gene in mice (*A^y*) causes obesity irrespective of color combinations carried with it, even when the yellow coat color is suppressed, as in albino combinations. The increased weight is due to excess fat, which is deposited particularly around the viscera and in the subcutaneous region (1). Obesity in these mice is due to increased food intake (2-4), as well as to less energy expended in body work (4). The latter fact agrees with the observation that these mice have a lower basal metabolism than normal mice (5).

Comparative growth curves have shown that the adiposity is more marked in yellow females than in yellow males. Also, ovariectomized nonyellow females become as obese as normal yellow females (1, 6). It was further pointed out (6) that both male and female yellow mice show a striking decline in obesity after 18 months of age. Obese yellow females show decreased fertility compared to other mice (1, 5); this has been denied (7), but the evidence in support of the latter view is not strong. Weitze (7) performed parabiotic experiments between various combinations of yellow and nonyellow mice. Her results indicate that the endocrine system of yellow mice is definitely related to the development of obesity in these animals. She studied the histology of the pituitary gland in obese mice and reported it to be normal.

The picture is further complicated by the observation that inbred yellow mice fail to become obese when fed normal laboratory diets (6), although they attain a body weight slightly greater than that of their non-yellow littermates (8). The tendency for inbred yellows to remain slightly heavier than nonyellows was also observed in the present study (Fig. 1), and, if

¹ The writer wishes to acknowledge his appreciation to C. P. Oliver and to W. F. Blair for their guidance and aid during the course of this problem.

² Rosalie B. Hite predoctoral fellow, Feb. 1951-Sept. 1951.

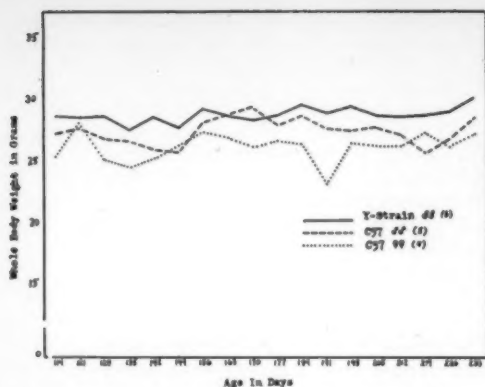


FIG. 1. Comparison of weight-age curves of inbred yellow males (Y-strain) and C57 (black) males and females. Note the tendency for inbred yellow males to remain slightly heavier than nonyellows.

fed a high fat diet, they become as obese as "hybrid" yellows on a normal diet. Nonyellow littermates do not become obese on a high fat diet (8).

In view of the fact that endocrine abnormalities are indicated in obese yellow mice (9), a comparative histological study of endocrine glands was undertaken. The mice used in the study³ were mainly of two genetic types, $A^y a$ (yellow) and aa (black). A few mice were used that carried the chinchilla gene homozygous, $c^{ch} c^{ch}$, in addition to the $A^y a$ genes; these mice are cream in color and become obese. Mice of these genetic types were divided into five age groups ranging from 35 to 360 days of age. Endocrine glands were studied from 24 black mice and 20 mice carrying the yellow gene; both sexes were included. These animals had not been mated for at least 1 month prior to the study.

Animals were killed by etherizing, and the thyroid and adrenal glands and testes or ovaries were rapidly dissected out in saline solution. These organs were fixed in Bouin's fluid, embedded in paraffin, and stained with hematoxylin and eosin. In order to obtain a valid comparison of ovaries from different animals, all females were killed during the estrus portion of their cycles, as determined beforehand by vaginal smears.

Quantitative determinations were made by use of a slide micrometer and camera lucida. Measurements were made of the height of the epithelial cells of the thyroid follicles, the largest diameters of thyroid follicles, and the widths of the different layers of the adrenal glands. A count was taken of the numbers of primary follicles, Graafian follicles, and corpora lutea per ovary, and measurements were made of the largest and smallest diameters of each of these follicle types in the ovaries. These comparative measurements were treated statistically to determine significant differences.

Results of the measurements, as well as of qualita-

³ The writer is grateful to L. B. Russell for her generosity in supplying some of the mice used in the study.

tive observations, revealed no significant differences in the thyroid glands, adrenal glands, and testes in the black mice and the mice carrying the yellow gene. The ovaries of obese yellow females showed significant differences from those of nonyellows. These differences include the presence of a few or no corpora lutea, a highly vascularized condition, and the presence of darkly stained cells in the fat tissue surrounding the ovary. The darkly stained cells appear to resemble the stroma of the ovary, but this particular anomaly needs further study. Photomicrographs of these differences are shown in Figs. 2 and 3. These ovarian anomalies are not found in yellow mice that are only slightly obese.

The presence of ovarian anomalies correlates with previously mentioned reports of low fertility in obese females (1, 5). Also, the onset of obesity coincides closely with the age at which sexual maturity is attained. This may be noted in various growth curves which have been published (1, 4, 6, 8). The writer also was unable to obtain successful matings using obese yellow females 8 months old. Further, it was difficult to obtain typical estrus stage smears from obese yellow females during a 2-week period. More data are being collected on the estrus cycle in obese females.

Sterility in obese females is apparently a phenomenon associated with obesity. Inasmuch as obesity precedes sterility and there are no ovarian anomalies in mildly obese mice, the path of gene action appears to be as follows: $A^y \rightarrow \text{obesity} \rightarrow \text{sterility}$. A

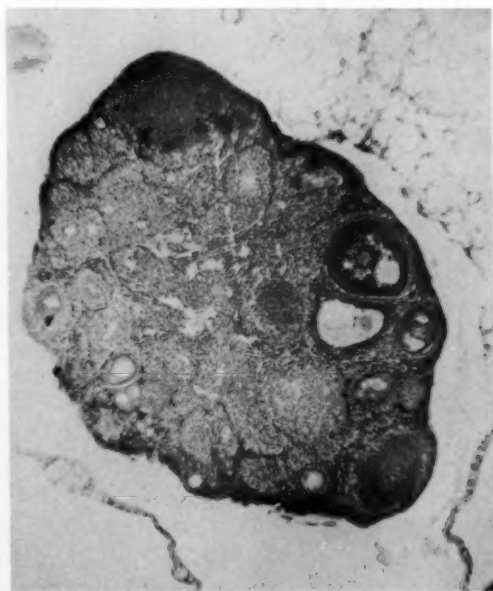


FIG. 2. Ovary from obese female 7 months old, weight 37 g. Note the many vascularized spaces. Atretic follicles and Graafian follicles are visible, but no corpora lutea are present.

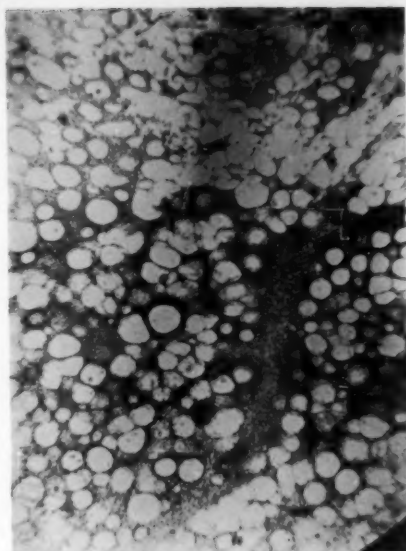


FIG. 3. Fat tissue surrounding ovary from obese female 8 months old, weight 42 g. Anomalous areas of darkly stained cells are widespread.

similar suggestion has been made recently by Ingle (10). This scheme is supported by observations of adiposity effects in preadolescent children, who commonly show delayed puberty. Simple weight reduction by dietary means results in the fairly prompt establishment of puberty (3). Obesity is also associated with other endocrine anomalies in man, some of which have a hereditary basis (9). It is conceivable that the path of gene action follows the scheme obesity \longleftrightarrow sterility, although this sequence is improbable in view of the observations discussed above. Pleiotropic effects have been observed in various organisms, but some of them have been shown to be spurious (11).

One might expect obese male mice also to show gonadal anomalies. This has been observed to some extent in rats made obese by overfeeding or by underactivity (10). Yellow males examined in the present study were only slightly obese, and their testes showed normal spermatogenic stages. In addition, spermatozoa and interstitial cells appeared normal when compared to black mice. It would have been desirable to examine the testes of very obese males, but because of technical difficulties, this was not done. More exact data on the fertility of these obese males, as well as inbred yellow mice, would also be desirable. Attempts to influence obesity and sterility by means of endocrine preparations have not yet been made.

Obesity in mice carrying the yellow gene is caused by an increase in food intake and less physical activity. These two effects of the gene are not primary ones and are mediated by metabolic dysfunctions involving the endocrine system. Data presented here support the

hypothesis that obesity resulting from this hormonal disorder upsets normal ovarian function, causing sterility. The possibility that the ovary itself is the site of the hormonal disorder causing obesity is not excluded by this hypothesis.

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Automatic Microtome

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This paper will describe a new instrument and method for automatically cutting and mounting thin sections of embedded biological specimens.

The manual method now used has several disadvantages. It is laborious, since the cut sections have to be mounted manually; the pressure of the knife on the soft impregnating material causes distortion, sometimes as much as 10%; the sections are not registered for rapid examination of corresponding areas. These disadvantages are inherent in the method of first cutting sections from the top of an impregnated block and then mounting them. Convenience and improvement of register should therefore be obtained by a method which, in effect, mounts the sections first and slices them off afterward.

The automatic microtome does in fact combine the operations of mounting and slicing in such a manner that the specimen tissue is supported by the mounting film during the slicing. As a result there is obtained

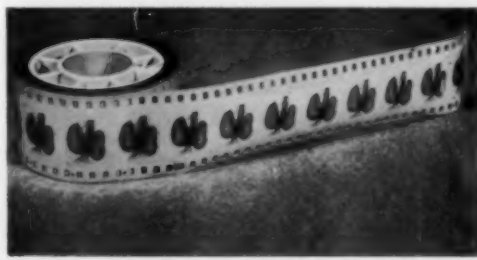


FIG. 1. Film .003" thick showing mounted sections of 90-mm pig kidneys.

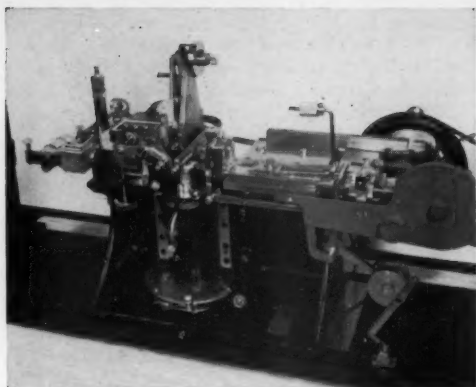


FIG. 2. General view of the automatic microtome.

a strip of film base with the sections mounted at intervals as shown in Fig. 1. Registration is precise with respect to the film perforations within the tolerances common to motion-picture technique. Since the section is firmly supported while being cut, distortion has been practically eliminated.

Fig. 2 shows a general view of the automatic microtome. A Spencer instrument was used as a basis for its development. The added features consist of a film-

handling mechanism and a device for pressing the film onto the block and guiding and supporting the film during the slicing stroke. The microtome is motor-driven at 10 sections/min, and controls are by cams so that all operations are automatic.

The film-handling mechanism follows motion-picture techniques except for departures necessitated by the use of thin base and relatively high tension. The film base used is of standard 35-mm width, but is thinner than standard.¹ With film .0035" thick it has been found possible to cut specimen sections down to 10 μ successfully. Film base .002" thick will permit thinner sections but is more difficult to handle. With thin base film of this sort, care is required in the construction of the film-advancing mechanism. This is of the usual claw type, with lateral registration obtained from the edge of the film. It has been found necessary to hold the film under considerable constant tension to ensure registration. Clamps hold the film during the slicing stroke. The claw mechanism operates on several perforations to avoid distortion at this point. Its stroke is limited by an adjustable stop in order to ensure longitudinal registration; the usual method of securing this by pins is not satisfactory with thin film in the presence of tension.

¹ Eastman Kodak Company and E. I. du Pont de Nemours & Company have kindly supplied special film.

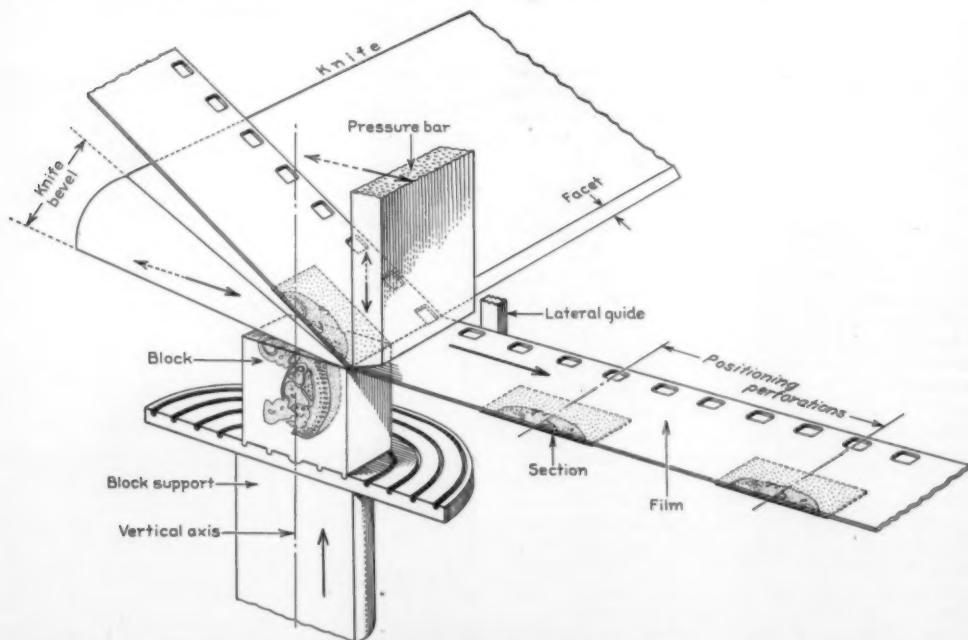


FIG. 3. Scheme for automatically applying serial sections to 35-mm perforated cellulose acetate film. This diagrammatic median view shows the block support carrying an embedded embryo, with the knife completing a cut with the pressure bar still in the functioning position. Forward motion is indicated by a solid arrow on the film, and reciprocal motions are indicated by solid-broken-line arrows. The lateral film guide moves with the pressure bar but is carried on a separate mount.

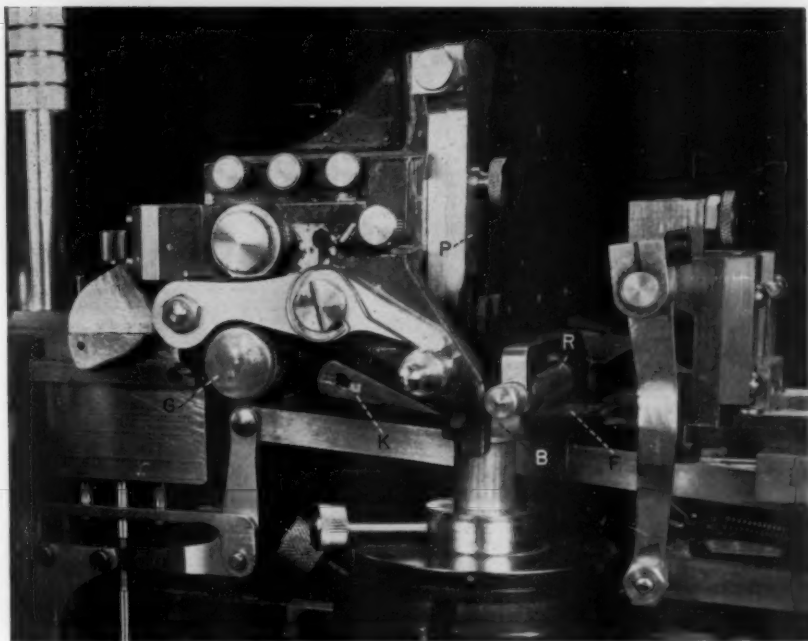


FIG. 4. View of construction of the automatic microtome. *B*, specimen block; *F*, film; *G*, guide roller; *K*, knife; *P*, presser blade; *R*, roller.

The heart of the device is the mechanism that guides and supports the film during the operation of the knife. The diagram in Fig. 3 shows the relations sought, and Fig. 4 gives a view of the construction.

The specimen, usually double-embedded to form a block, is at *B* in Fig. 4. The film *F*, when the knife is remote, is stretched over the surface of this block and in light contact with it. In this position it is advanced to a new frame and clamped. The roller *R*, the presser blade *P*, and knife *K*, and the guide roller *G* are mounted together on the knife carriage. There is provision for holding the tension in the film constant as the carriage moves forward.

In operation, the knife carriage advances carrying the presser blade across the block above the film and the knife blade through the block under the film. As the block is sliced the presser blade controls the curvature of the film at the point of cutting the double-embedded matrix and tissue. Full bonding occurs practically simultaneously with the cutting. The roller *R* is employed to keep the film clear of the presser blade on its return stroke. With double-embedded specimens and acetate film base, good adhesion is obtained without added adhesives. After the section is cut, the presser blade is raised and the knife carriage returns, whereupon the film is advanced and clamped for the next stroke.

The position of *P* with respect to the knife edge needs careful adjustment. It must be brought parallel to the knife edge by two adjustments and set at a

proper distance in advance of the knife. The pressure it exerts is adjustable, and there is a stop to prevent it from descending too far. The positions of the knife and the guide roller and the tension are also adjustable. These are all fairly critical adjustments. When they are once made, the device will operate indefinitely to give satisfactory sections of a given thickness.²

The film with its mounted sections is surprisingly rugged. It has been found desirable, however, to wind a thin protecting film with the working film as it goes onto the take-up spool.

Sections mounted on film in this manner are convenient to use. Treatment, such as staining, may be done while handling the film, by the usual photographic equipment. In this connection it will undoubtedly be desirable to use film base material other than cellulose acetate for some processing purposes. Projection or examination under the microscope is facilitated, since ordinary 35-mm film-handling equipment can be used to bring successive sections into register. Copies may readily be made with ordinary motion-picture equipment. The basic principle of the microtome—that is, the support of the section during the period when it is being cut—has been applied to

² The first model of the machine was built by W. R. Horsfield, now of Bermuda. My thanks are especially due to Osborne O. Heard, of the Department of Embryology, who carried out the difficult process of removing faults from the machine, and succeeded in producing excellent sections. W. F. Steiner and L. A. Horton, of the Department of Terrestrial Magnetism, made final alterations necessary for fully precise registration.

frozen sectioning techniques. Certain other manipulations, to be described in later papers, are also facilitated.

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Histochemical Demonstration of 5-Nucleotidase Activity in Cell Nuclei¹

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Evidence has been brought forward recently which seriously questions the value of histochemical methods for the localization of alkaline (1) and acid (2) phosphatase within cellular structures. In the case of alkaline phosphatase, nuclear staining is seen in many tissues with the Gomori (3)-Takamatsu (4) technique, but not with the azo-dye method (5, 6). All or part of this nuclear activity may, however, be due to unspecific staining, since cell nuclei absorb phosphatase, which readily diffuses from tissue components with high activity, as well as calcium phosphate which has been split off the substrate in the Gomori-Takamatsu method (1, 7-9).

In the present communication, evidence is presented that an enzyme attacking adenosine-5-phosphoric acid (muscle adenylic acid), first found by Reis (10, 11) in various tissue extracts, can be localized not only in the cytoplasm but also in the nuclei of some tissues. Such a 5-nucleotidase, differing from the unspecific phosphomonoesterase, has been previously demonstrated histochemically (12, 13).

Thin slices of tissue were fixed in ice-cold acetone for 24 hr, then dehydrated for 24 hr in absolute alcohol or cedar wood oil and cleared in 2 changes of xylol for 1 hr each. Paraffin sections were cut at 5 μ and incubated in the substrate at 37° C. The substrate contained 1.44×10^{-3} M adenosine-5-phosphoric acid,² 8.0×10^{-2} M calcium chloride, 1×10^{-2} M magnesium sulfate, and 2×10^{-1} M 2-amino-2-methyl-1,3 propane-diol buffer at pH 8 (14). The sites of formed calcium phosphate were visualized by treatment with cobalt nitrate followed by diluted ammonium sulfide. The adenosine-5-phosphoric acid was added to the substrate mixture as dry powder (50 mg/100 cc). In preliminary experiments this amount was found to be the smallest that gave satisfactory results. The concentration of calcium chloride was within the range suggested recently by Gomori (12, 15). Gomori pointed out that a high concentration of calcium would substantially decrease the solubility of the formed calcium phosphate and thus prevent unspecific staining caused by secondary absorption of the dissolved calcium phosphate from the substrate.

¹This work was supported by a grant from the Damon Runyon Memorial Fund for Cancer Research, Inc.

²The adenosine-5-phosphoric acid was obtained from Sigma Chemical Co., St. Louis, Mo., and from Schwarz Laboratories, Inc., New York. Identical results were obtained with both preparations.

Myometrium of fresh surgically removed uteri and aorta of recently killed rabbits was used. In both tissues the usual technique for demonstrating alkaline phosphatase with glycerophosphate as substrate buffered at either pH 8 or pH 9 revealed only staining of capillaries in the myometrium and of the endothelial layer in the aorta. No other structures showed activity even if the incubation time was extended to 12 hr.

5-Nucleotidase activity was demonstrable in the cytoplasm of smooth muscle fibers, interstitial fibroblasts, and the cells composing the wall of the myometrial arteries after 3 min incubation and increased markedly in the following minutes. Staining was always diffuse and even. The coating of sections with celloidin did not alter the results. For comparison, frozen sections cut at 10-15 μ were prepared from fresh, unfixed uteri, as well as from material which had been fixed for 24 hr in ice-cold acetone. In these preparations enzymatic activity in cytoplasm and nuclei could be recognized after 2-3 min and was quite distinct after 4 min. The distribution of histochemically demonstrable enzymatic activity was identical with that seen in paraffin sections. Excellent preparations for microscopic study were obtained in paraffin sections after an incubation period of 10-60 min. Within the nuclei the nuclear membrane, nucleoli and chromatin particles were stained. Within the cytoplasm of both the smooth muscle cells and the fibroblasts fine dark staining fibrils could be recognized (Fig. 1). If the incubation period was extended over

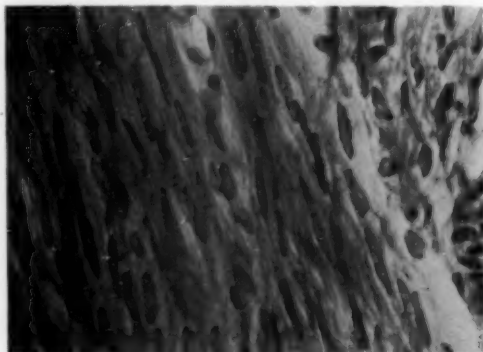


FIG. 1. Myometrium from human uterus. Paraffin section incubated for 10 min. Note prominent nuclear staining and fibrillar structure of cytoplasm. $\times 500$.

several hours, all cellular details were obliterated by the heavy deposit of calcium phosphate after its visualization as dark cobalt sulfide.

With the rabbit aorta activity was demonstrable in 6 min and was quite distinct after 10 min incubation in paraffin sections (Fig. 2). Nuclear staining in smooth muscle fibers and fibroblasts was as prominent as in the myometrium. The cytoplasm of these cells showed a comparable amount of activity, whereas the elastic membranes remained completely unstained.

In order to establish the optimal pH range for the



FIG. 2. Rabbit aorta. Paraffin section incubated for 10 min. $\times 500$.

histochemical demonstration of 5-nucleotidase activity, sections of uterus and aorta were incubated for 1 hr at 37°C in a substrate mixture of which the pH was varied between 7 and 9.5. This was accomplished with a $2 \times 10^{-1} M$ tris (hydroxymethyl) aminomethane-maleate buffer (14) for a pH of 7 to 7.8 and with a $2 \times 10^{-1} M$ 2-amino-2-methyl-1,3 propanediol buffer (14) for a pH of 8 to 9.5. The results with both tissues were identical. Incomplete staining was seen with a pH of 7 to 7.4. Optimal intensity was observed between a pH 7.5 and 8.2. Between pH 8.4 and 9.5 the histochemical staining reaction was decreased in intensity. This decrease was noticed both in the cytoplasm and in the nuclei.

The incorporation of magnesium in the incubation mixture is not essential. Comparison of adjacent sections of aorta and uterus incubated with and without magnesium sulfate revealed that magnesium caused a moderate increase of enzymatic staining for both organs up to 1 hr incubation. With incubation times of 2 hr or longer staining became so intense as to obliterate any difference.

If magnesium was omitted from the incubation mixture, activity was completely inhibited by addition of $1 \times 10^{-3} M$ potassium cyanide in sections incubated up to 2 hr. If, however, magnesium was present in the substrate mixture, the inhibiting effect of potassium cyanide was not complete, and residual enzymatic activity was present in sections incubated up to 2 hr. Cytoplasmic activity was more inhibited than nuclear staining.

In order to examine the occurrence of unspecific nuclear absorption staining, the following tests were carried out with paraffin sections from myometrium which had been inactivated by immersion in 0.25% nitric acid for 5 min. (1) Active paraffin sections of uterus were mounted over inactivated sections, covering part of the latter (7, 15, 16). No diffusion staining was noted up to 2 hr incubation. After 4 hr some nuclei of the inactivated sections showed slight staining adjacent to the active sections. Only when the incubation was further extended did diffusion staining become marked, although it was limited to a very

narrow area adjacent to the by now markedly overstained active sections. (2) When an active and an inactive slide were put face to face and slides were separated by a strip of celluloid film and fastened together with a rubber band (15), identical results were obtained as described above. Up to 2 hr there was no diffusion staining in the nuclei of the opposite inactivated sections. There was faint nuclear staining after 4 hr, which became more distinct if the incubation time was extended beyond 6 hr. (3) Inactivated sections were incubated in the substrate to which dilute H_2O_2 (5 ml of a freshly prepared 3% solution for 100 cc of substrate) had been added. This produces a slow precipitation of calcium phosphate in the substrate mixture (8, 16). No nuclear staining occurred up to 12 hr. If, however, the inactivated sections were incubated in the usual glycerophosphate substrate at either pH 8 or pH 9, absorption staining became quite marked after 6 hr incubation.

In contrast to recent reports in which a predominantly nuclear localization of acid phosphatase was found in paraffin sections and cytoplasmic localization in frozen sections (17, 18) identical localization of 5-nucleotidase activity occurring in nuclei and cytoplasm was noted in both frozen sections of unfixed and acetone-fixed material and paraffin sections. This activity was demonstrable within a few minutes, whereas no nuclear staining whatsoever was seen if glycerophosphate was used as a substrate even after many hours of incubation.

None of the artifacts that are due to nuclear absorption staining either by diffused enzyme or liberated calcium phosphate occurred at the short time interval in which optimal staining was observed (19). Furthermore, fractionation studies have shown that although acid (2, 20) and alkaline (20) phosphatase, at least in the rat liver, are predominantly localized in the cytoplasm, the enzyme-splitting adenosine-5-phosphoric acid is concentrated to a large portion in the nucleus (20).

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Comments and Communications

Areal Differentiation and the "Science" of Geography

SOME professional geographers hold the essence of geography to be areal differentiation. This concept presumably involves a description of the respective regions or areas of the earth and, possibly, an interpretation of the observed differences. We challenge the point of view as untenable if it is not based upon certain fundamental and established principles, which may be utilized as standards of reference. Few would quarrel with the presumption that a function of the geographer is to observe and to describe the characteristics of different (natural and cultural) landscapes. For convenience in accomplishing this purpose it is his privilege to divide the earth's surface into limited areas or regions. If, however, he merely concentrates upon pointing out differences among the landscapes he has described, he will not advance his science very far, if at all. In fact, if this is all he does, the geographer has little right to refer to his field as a science.

If a science consists of the knowledge of principles, laws, and general truths, as authoritative interpreters and historians of science assert, then a study limited to the differentiation of areas will not permit the inclusion of geography in the category of science. Principles, laws, or general truths cannot be derived from a mere comparison of differences. Before their significance can be determined, a standard of reference must be established. Circumstances may differ from each other, and each set of differences may have its own explanation, but only when these differences have a common cause can there be a scientific generalization or interpretation. If science be defined merely as a branch of systematized knowledge, then any branch of learning is a science, in which case geography would be so identified. But this is a point of view to which we cannot subscribe.

In contrast with the consideration of geography in terms of areal differentiation, we wish to emphasize the point of view of Ritter, who suggests a comparative approach in which similarities are emphasized. The few geographers who have engaged in micro-regional investigations have made an excellent beginning in the Ritterian approach. A vast number of such studies needs to be made. If we can find enough cases over the earth's surface to demonstrate that life will always respond in the same manner to certain circumstances, or that landforms will always evolve according to a given order, or that atmospheric behavior will always be the same under given sets of conditions, then we shall have discovered laws or general truths, on the basis of which we may make predictions. Only then shall we have established geography as a science.

Geographers borrow from many fields, but to what purpose? Is their purpose merely to correlate those

elements which together constitute a landscape,¹ to describe the landscape, or to differentiate it from another area? We are reminded of a question often propounded by the late O. E. Baker to aspiring students writing theses: "What is there in your description that a good journalist could not have done as well or even better than you?" If the function of the geographer is merely to describe and differentiate, he contributes little or nothing that is unique. Such an effort does not necessarily require a formal geographic training. The same end might be achieved by one who combines skill both in observing and in using language. If geography includes, in addition to areal differentiation, an interpretation of differences, as some do concede, then it begins to take on significance. But somewhere there must still be established a standard of reference against which interpretations of differences may be checked and tested for their validity.

We recognize the difficulties that confront the geographer when he seeks to discover general truths or principles concerning mankind in relation to the physical earth, in contrast with the physicist or the chemist, who can make determinations in a laboratory where he can set up controls as standards of reference, and where he can examine performances at will under easily regulated conditions. Man, possibly the most complex of all variables, cannot be harnessed to make possible a repetition of a given behavior in the presence of a prescribed set of conditions. Not only is he himself a variable reflecting both inherited characteristics and sensitivity to environmental adjustments, but his natural environment is a variable, perhaps never being exactly reproducible. We need not completely despair. A given set of natural conditions can be approximated on different parts of the earth's surface with sufficient frequency to yield a pattern which for all practical purposes can be interpreted as a standard of reference. Studies of man's behavior in the setting of that pattern, appropriately compared, offer us some hope of deriving a correlation that may lead to a principle or law. Not until investigations are carried on with the purpose of uncovering a series of identical situations can we stabilize the field of geography and make it truly useful. From the accumulation of a vast number of observations in which similar conditions occur, we may be able to generalize and establish standards of reference. Then, wherever we find departures from the standard, we may be able to interpret them, confident of the validity of our conclusions.

We desire to stress the difference between the philosophies of areal differentiation and of the comparative method for purposes of discovering similarities.

¹ We use the word "landscape" in an all-inclusive sense—all the elements, organic and inorganic, within a circumscribed or delineated area.

Again referring to Ritter's methodology, we may note that he compiled abundant data by means of systematic studies of regions, compared the findings, and sought to derive principles. Even though he did not attain great success in this effort, his approach was nonetheless in the right direction. To illustrate our point with a case from the plant world, let us suppose that we have observed a species of plant growing under a given combination of soil, drainage, and microclimatic conditions. Suppose we then map the distribution of the species and note that the physical environment is essentially the same, rarely revealing an exception. Looking over the results of this investigation and noting the similarities, we would feel quite safe in making some generalization with reference to the habitat of the plant and its behavior in a given environment. We could even go so far as to predict where such a plant species may be expected. In contrast, if we had merely observed that this species does not grow where another does grow, or had observed that the conditions under which it grows differ from those under which other species thrive, we could not have determined the optimum conditions for any species, nor derived any guiding principles.

The comparative principle involving the accumulation of many repetitive cases is the same whether we consider plants, lower animals, man, or even physical phenomena such as landforms. Suppose we observe areas A and B, noting that in A, manufacturing activities are dominant, whereas in B agricultural occupations attract most of the population.² Under the program of areal differentiation our first function would be to describe what takes place in each area. In describing the landscapes we would have made a contribution to the realm of geography, since description is a legitimate and necessary phase of the field. If next we sought to find out why the uses of the lands differed, we might have learned that the reasons were to be found in economic, environmental, physical, or still other circumstances. Then what? Would we have been able to conclude that because of these differences certain reactions would always be true? Suppose we had compared area A with areas C, D, E, F, and many more, always finding that there were differences. Would these comparisons ultimately have brought to light criteria that would enable us to predict the circumstances under which a given area would become dominantly manufacturing, agricultural, or something else? Would such observations have revealed the limiting elements with respect to the uses man could make of any area? On the other hand, had we made a systematic study of A and of all other manufacturing areas, seeking to find elements in common, or had we made a systematic study of a given set of physical conditions that would permit man to do any one of a variety of things and had followed this with a study of all such areas on the earth to see

² Although we have been emphasizing here the human relations aspect of geography, we do not subscribe to the notion that there is no geography where there is no human occupation. The field of geography is more inclusive than mere human ecology.

whether man reacted in the same way everywhere, then we should have set the stage for the possibility, at least, of discovering some principles. Our approach would have been positive. It seems to us that only through this approach—that is, description, analysis, and comparison of like areas—can we hope ultimately to derive standards of reference and to place the field of geography upon a firm scientific foundation.

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Cloudiness in Relation to Choice of Astronomical Sites

THE article "Optimum Location of a Photoelectric Observatory," by John B. Irwin (*SCIENCE*, 115, 223), represents a gratifying application of climatological data to a specific practical problem. There is, however, an unfortunate characteristic of the basic data that partially vitiates the conclusions drawn. As an astronomer, Irwin is interested in cloudiness at night, but the basic means of detecting clouds, the human eye and the sunshine recorder, are both most effective during the day. In addition, there are good physical reasons for believing that the spatial distribution of daytime cloudiness may be quite different from that of nocturnal cloudiness.

Daytime clouds tend to be of the cumulus variety and are often caused by solar heating of relatively moist air near the ground. These clouds are at a minimum near Yuma, Ariz., as Irwin points out, and this is due to the pronounced dryness of this region and the prevailing subsidence in about the lowest half of the atmosphere. Nighttime clouds tend to be of the stratiform variety and are usually due to large weather systems, such as frontal storms and cyclonic circulations aloft. The higher nocturnal clouds, at least, should then be relatively independent of the low level factors that produce the minimum of cloudiness near Yuma. One would then expect, for example, that cirrus, Irwin's "photoelectric poison," would not exhibit the same pronounced minimum of occurrence over Yuma that daytime cumulus shows.

Irwin concludes that the region within 40-48 miles of Yuma is far superior for photoelectric photometry of stars to any other region in the United States. It is my feeling that this is too restrictive a conclusion. I would hazard the guess that, if the proper nocturnal data were to become available, the entire southwestern United States, including southern California, all of Arizona, New Mexico, and western Texas, would be found about equally suitable. Unfortunately, reliable data on nocturnal cloudiness are almost nonexistent. A major factor in this deficiency is the difficulty of detecting thin cirrus at night.

In the absence of appropriate nocturnal data, I suggest that the apparent superiority of the Yuma region be discounted, and plans for a photoelectric observatory be broadened to include the above-mentioned states. Certainly one should not forego such practical

advantages as accessibility, readily obtained power, good seeing, etc., in order to locate in a region where advantage in lack of clouds is probably spurious.

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DR. HESS has suggested—and given reasons for—the interesting possibility that the spatial distribution of nocturnal cloudiness may be quite different from that of daytime cloudiness. This is an important point that should be, and will be, investigated further. The most successful method of attack would seem to be to analyze only the cloudiness data taken at night at those times when the moon was above the horizon. Thin clouds, if present in an otherwise clear sky, should be visible at such times.

The limitations of the immediately available meteorological data that I had to use were acutely in mind when I wrote the paper, and, of necessity, my conclusion concerning the superiority of the Yuma region as the site for a photoelectric observatory was a qualified conclusion that needs further testing. Its superiority seemed to be so pronounced, however, that it was felt to be worth while to call attention to it in print, if only as the first approximation. If it turns out that the nocturnal cloudiness is about the same over a large area of the Southwest, the question of good seeing undoubtedly would be paramount. With a wider area to choose from, a better and more accessible site might perhaps be located.

The other points that I made in my paper seem to need no qualifications: namely, (1) that photoelectric photometry has become of fundamental importance in modern astrophysical research, (2) that the climatological requirements are different for it than for other types of astronomical observational routines, (3) that there is a widespread need among Midwestern and Eastern astronomers for photoelectric research opportunities in an excellent climate, and (4) that such an observatory could be established at a fraction of the cost of a very large reflector.

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The Aeropause

THE upper boundary of the atmosphere is commonly identified with that region of the exosphere where the uppermost geophysical phenomena—namely, the highest auroras—are occasionally observed. In terms of this concept the limit of the atmosphere is located at about 1000 km above the surface of the earth. The peak of the highest rocket trajectory attained so far—400 km—lies within the boundaries of the atmosphere. For all practical purposes of rocket engineering, however, the atmosphere ceases to exist at an altitude of 180–200 km. Unmanned rocket craft are routinely reaching beyond the physically effective regions of the atmosphere, and manned flights into the border

region of the atmosphere and, eventually, space must be considered a definite possibility. Consequently, a new concept of the borders of the atmosphere seems necessary. This concept should be based on the functions which the atmosphere fulfills for man and craft, such as supplying breathing oxygen or aerodynamic lift and drag. A functional border between atmosphere and space is defined as that level at which the atmosphere fails as a supporting medium, and space-equivalent conditions begin. Depending on the particular kind of function, the corresponding limit is located at a certain altitude. From this point of view the following functional borders can be listed:

Function	Altitude (km)
1. Contributing to respiration	16
2. Preventing boiling of body fluids	19
3. Sustaining combustion of fuel	21–23
4. Absorbing heavy primaries of cosmic radiation	21–36
5. Absorbing solar ultraviolet between 210 and 300 mμ (Hartley band of O ₂)	35–45
6. Supplying aerodynamic lift	80–110
7. Supplying diffuse daylight	100–140
8. Absorbing meteors	110–150
9. Interacting thermally with the craft (compression and friction heating)	160–180
10. Interfering by air drag over long periods of time (permanence of satellite orbit)	200

In addition to these data it may be mentioned that the presence of ozone above the 13-km level can result in toxic concentrations of this gas in the cabin air, if the pressurization of the cabin is maintained by compressing ambient air.

Of course the borders so defined are more or less extended regions. Especially are the functions mentioned under 6, 9, and 10 dependent on the velocity of the craft, and the altitude data given are related to a velocity of the order of 8 km-sec. This velocity must be attained in order to establish a craft in a permanent satellite orbit around the planet. Above an altitude of 200 km there are only three factors of terrestrial origin that make the environment of the craft and its crew different from that found at any other point in interplanetary space: (1) the bulk of the earth, which shields off half the number of meteors and cosmic ray particles; (2) the magnetic field of the earth, which deflects cosmic ray particles below a certain magnetic rigidity, if they approach the earth in or near the equatorial plane; (3) the radiation reflected and emitted by the earth and its atmosphere.

The problems that arise in the operation of manned vehicles at very high altitudes and eventually in free space are of an extremely diverse and complex nature. Their solution requires contributions from meteorology, geophysics, astronomy and astrophysics, cosmic ray physics, aerodynamics, radiobiology, physiology, aviation medicine, general medicine, bioclimatology, and human engineering.

Owing to the many different fields involved, semantic difficulties must be anticipated; particularly, the

term "upper atmosphere" is misleading, since it conveys different meanings in the various fields such as meteorology, geophysics, and aviation medicine. For the common benefit it appears expedient to coin a new term for designating the regions of the atmosphere where—in terms of manned rocket flight—the conditions of conventional aviation blend into those of actual space flight. To this end the term "aeropause" is suggested. The aeropause is defined as that region of the atmosphere where its various functions for man and craft begin to cease and space-equivalent conditions are gradually approached. The concept of the aeropause appears to be quite useful in modern aviation; it circumscribes the area characterized by certain factors of environment that are distinctly different from those found in the area of conventional aviation or of space. The aeropause encompasses approximately the region between the 20- and 200-km levels.

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Lipochondria of Living Nerve Cells

IN A recent letter to *Nature* A. J. Dalton (1) reports the identification of the Golgi apparatus in mammalian duodenal and liver cells by the aid of the electron microscope following their fixation and sectioning. Similarly, there has been a recent tendency to report observations of the Golgi apparatus in fixed tissues after examination with the phase-contrast microscope (2-5). Of the authors mentioned, Barer alone was careful to point out that, although use was made of a new observational technique, fixation artifact remained in the tissues under examination.

After a cell is killed and fixed with chemical substances, then dehydrated, embedded in wax, and sectioned, it would seem that delicate intracellular structures must inevitably be distorted to some degree, with the possible production of artifacts. Whether we then stain these sections with dyes in order to render their details visible with the ordinary microscope or, instead, view the unstained sections with the electron or phase-contrast microscope seems unimportant, since the basic objection—the possibility of fixation artifacts—remains.

Clearly, the enigma of the Golgi apparatus can only be resolved by reference to the living cell. It is unfortunate that the electron microscope cannot be used for the study of living tissues, and in this respect Dalton's observations are necessarily limited. On the other hand, the phase microscope can and has been used in an attempt to see the Golgi apparatus in freshly isolated cells suspended in indifferent media (6-9).

Since 1946 the writer has been concerned with the phase microscopy of nerve cells of both vertebrates

and invertebrates. Ever since Golgi's original observations on the Purkinje cells of the owl, the neuron has remained the classical site for the study of the internal reticulum. Here one can observe a large, elaborate Golgi apparatus, provided one kills and fixes the cells by means of appropriate technical methods. However, intensive study with the phase microscope has failed to reveal anything corresponding to the elaborate internal reticulum in living neurons. Instead, these studies have provided strong confirmation of the existence in the living nerve cell of the bodies described by John R. Baker, of Oxford, in 1944 and since named by him "lipochondria." These bodies are clearly distinguished by their reactions to vital dyes and can be readily observed by any person possessing a compound microscope, suitable dyes, and slides and needles for teasing tissues.

As the classical Golgi apparatus fails to reveal itself in living cells, it is tempting to assume that the lipochondria form part of the living counterpart to the "apparatus" of the dead and treated cell. This suggestion is strengthened by the knowledge that the lipochondria are osmiophilic, and it seems very likely that they act together with the mitochondria as centers, or foci, for the netlike nonspecific deposition of osmium and silver within the fixed cell during the prolonged immersion of the tissues in the impregnating fluids (8).

Much work remains to be done on this fascinating problem, but it is questionable whether any real advance in cytoplasmic cytology is likely to come from the employment of methods such as those of Dalton and Gatenby. The fixed preparation is seldom more than a caricature of the living cell, and it does not matter much how we view it—whether by the ordinary microscope or by the electron microscope. We must study living cells instead of searching with new tools in the wreckage of the cell following death and dehydration. The fresh and novel approach to cytology that has come from Baker's laboratory has already produced many new facts concerning cell organelles and promises to continue to do so. The time may well come when the Golgi apparatus will be discussed merely as an interesting reaction that can occur in a cell when it is subjected to certain chemical and physical conditions.

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Book Reviews

Industry and Tropical Health. Proceedings of the First Industrial Tropical Health Conference, sponsored by the Harvard School of Public Health, December 8-10, 1950. Boston: Harvard School of Public Health, 1951. (Published for the Industrial Council for Tropical Health.) 292 pp. and appendix. \$10.00.

The First Industrial Tropical Health Conference was organized by the Harvard School of Public Health to bring together a selected group of industrial physicians experienced in tropical medicine and tropical public health and executives of various corporations having extensive tropical operations. It was believed that exchange of information and discussion of problems might be helpful to the organizations concerned and contribute to a pattern of education in industrial medicine oriented to the special problems of the tropics.

The book is arranged in 12 sections corresponding to the conference sessions. Among the topics included are discussions of industry and health in the Middle East, in tropical Africa, in the Far East, and in tropical America; and organization of industrial health services, nutrition, infectious diseases and problems of control, and industrial health hazards. The contents are well indexed.

This volume is a unique and valuable contribution, since it presents the views of authoritative individuals in tropical corporation management and those of physicians experienced in the development and administration of industrial medical services in the tropics. As one of the essayists points out: "Tropical industry differs from domestic industry in that labor and environment are substandard. . . ." And, "Stabilization of labor is the key to a successful . . . venture in the tropics." Accomplishment of this objective is beset by many difficulties. Communicable diseases and malnutrition in many areas create both shortage and physical inefficiency of labor. Illiteracy and social anthropologic factors create barriers to the acceptance of the scientific approach to problems of treatment and prevention. Frequently, national laws or demands of labor complicate the development and operation of an industrial medical service. It is not surprising that costs are high—in the case of one corporation approximating 4.5 per cent of the tropical payroll—nor that these costs have been a deterrent to the development of effective programs in tropical industrial medicine.

Emphasis is placed on the fallacy of separating curative and preventive medicine and upon the essential importance of the latter. Uncontrolled curative medicine rapidly becomes prohibitively expensive. It is pointed out that the ultimate objective of a tropical medical service for industry should be a cooperative relationship among government health agencies, professional associations, and industry to improve sani-

tation and health conditions and facilities for medical care in the area.

This volume represents a significant contribution to the growing field of tropical industrial medicine—a complex spectrum of exotic medicine, epidemiology, sociology and anthropology, economics, and business administration. It is regrettable that certain of the topics could not have been amplified and additional ones included, but one hopes that, in accordance with the concept of the sponsors, it will lead to further development of this field. The book will well repay study by the physician interested in tropical industrial medicine as well as by the management of industry operating in the tropics.

THOMAS T. MACKIE

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Elsevier's Encyclopaedia of Organic Chemistry: Carboisocyclic Condensed Compounds, Series III; Tetracyclic and Higher-Cyclic Compounds except Steroids and Triterpenes, Vol. 14, Suppl. F. Radt, Ed. Amsterdam-Houston: Elsevier Pub., 1951. 938 pp.; 113 pp. index. \$88.00; set subscription price, \$66.00.

Elsevier's Encyclopaedia of Organic Chemistry is a compilation in English on the chemical and physical properties and on the most important physiological properties of organic compounds. Several volumes have already appeared since 1946, and previous reviews have described the general outline of the planning and mode of presentation. The authors have wisely confined their initial efforts in this tremendous undertaking to Series III, Carboisocyclic Condensed Compounds, because of the general interest in such compounds and the lack of adequate assemblage of information in this area.

The present volume is the first of two parts of a supplement to Volume 14 on Tetra- and Higher-Cyclic Compounds, which appeared in 1946. Volume 14 covered the literature through 1936. This part of the supplement embraces all the literature between 1937 and 1946, including patents, on tetra- and higher isocyclic compounds, with the exception of steroids and triterpenes, which will form the contents of the second part. Investigations that involve a change of structure of substances previously described in the literature are considered up to 1951. The number of pages of literature between 1937 and 1946 on this subject is many times the number prior to 1937; the number of ring systems has increased 60 per cent. The expansion of research in this field may be realized by noting the 938 pages devoted to this part of the supplement as compared with the 611 pages in the main volume. The subject and formula indices cover all entries in the main as well as in the supplemental volumes.

Chemists engaged in the study of polycyclic compounds will find this volume invaluable.

ROGER ADAMS

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Sexual Behavior in Western Arnhem Land. Viking Fund Publications in Anthropology, No. 16. Ronald M. Berndt and Catherine H. Berndt. New York: Wenner-Gren Foundation, 1951. 247 pp.; 24 plates. \$4.00.

This monograph, by Mr. and Mrs. Berndt, and edited by Ralph Linton, on the sexual behavior of North Australian aborigines, is an important and impressive ethnographic report. That the authors speak with an authority based upon intensive and extended field research is clear. Throughout the monograph their generalized statements of social behavior are illustrated and substantiated by a wealth of detail. The reader gets the impression that the details have been judiciously selected from a much larger fund of experience that could have been exploited had this seemed desirable.

The report contains information on a wide range of social activities related in one way or another to sexual behavior. Considerable attention is paid to the social structure and its concomitant regulation of sex partners. Religious and ceremonial activities are portrayed in great detail, with particular reference to implications for reproductive processes. An especially interesting section is devoted to what the authors call "Gossip Songs." These are relatively recent compositions that relate in song form personal incidents in social life. Most of the songs concern the behavior of lovers and married people, and these are the ones illustrated in this report.

A somewhat disappointing section to this reviewer is the one in which the authors discuss sexual experience in the life cycle. The material is sketchy and lacks the wealth of detailed documentation characteristic of other sections. This may be explained in part by the rather curious attitude expressed by the authors in their introduction. They state (pp. 16-17):

What does not particularly concern us here is the sexual act itself—the accentuation of the erotic content of activity, or the actual resultant physical and emotional pleasure; in the same way, the swallowing of a piece of food is of minor and purely personal consideration when taken in conjunction with the wider importance and social associations of food.

To state our thesis briefly: the sexual act and the accompanying erotic play are incidental and personal, while the events leading up to, surrounding or resulting from this subject, and the institutions involved, are of general social importance to the community.

To be sure, sexual activities are personal, and so are such activities as eating, talking, and sleeping. But it is on the basis of observations of and/or hearsay about personal activities that an ethnographer builds a picture of the social customs and institutions that characterize a society. It is certainly of utmost importance to relate sexual behavior to other aspects

of culture, but this does not imply ignoring the sex act. Nor, in fact, do the authors themselves comply wholly with their self-imposed restriction. Much valuable descriptive material on sexual behavior proper is to be found in the report. The point is simply that it could have been an even more useful study for many readers had the authors not striven to maintain an essentially fictitious dichotomy between personal and social activities.

Perhaps the most significant lesson of the monograph for future field work is the demonstrated advantages of having a man and his wife cooperate in the investigation. The advantages of such teamwork stand out prominently in the study of reproduction and sexual behavior. But they are probably of considerable importance in the study of any aspect of human behavior and culture.

CLELLAN S. FORD

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Finite Matrices. W. L. Ferrar. New York: Oxford Univ. Press, 1951. 182 pp. \$4.00.

Interest in the theory of matrices has spread far and wide in the past few decades, but until recently very few texts were available in this field. Since the war many writers have been at work fulfilling this need. *Finite Matrices* is one of the latest in the post-war crop.

Various portions of the theory were included in an earlier work by Ferrar entitled *Algebra*. The author's aim in the present text is to complete the theory in such a way as "to make the argument simple and straightforward," so that it "can be read with reasonable ease." A fair measure of success in this purpose has been attained. On almost every page it is clear that the author was seeking out the difficulties in the subject and looking for lucid presentations. This makes it all the more surprising to find very often, in definitions, theorems, and proofs, that he lapses into a conversational style in which meanings are merely suggested rather than stated explicitly and accurately.

The definition of linear dependence (given by suggestion after treating only the case of three vectors) is wrong in that it requires a linear combination to vanish with at least two coefficients not zero.

The greatest drawback of the book as a text is the broad knowledge of matrix theory it initially assumes. This includes the theory of rank, the Cayley-Hamilton theorem, and the reality of the roots of a Hermitian matrix, for all of which the reader is referred to the author's *Algebra*. It is clear that *Finite Matrices* can be used as a text only on condition that the students have first had a course in Ferrar's earlier text.

After an introductory chapter summarizing the assumed results, the book gets down to work with a chapter on equivalence. One preparatory chapter then leads to the major topic of collineation (similarity) in which the method employed for the most part is the use of suitable pairs of elementary transformations.

Later the author deals with the well-known theories of orthogonal and unitary similarity, but in the latter he studies only Hermitian matrices rather than normal matrices in general. Characteristic vectors are, of necessity, implicit in these discussions but are not treated explicitly. A long chapter is devoted to infinite series and functions of matrices, providing the only recent systematic account of this topic. The book closes with a brief treatment of matrix equations and a few miscellany.

SAM PERLIS

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Reviewed in Brief

Modern Magnetism. 3rd ed. L. F. Bates. New York: Cambridge Univ. Press, 1951. 506 pp. \$5.50.

This third edition of the well-known book by Bates has not only been brought up to date and considerably enlarged, but the material has been rearranged in order to treat a number of new subjects not previously treated, and at the same time follow a more logical sequence. The material is now subdivided into 12 chapters. Chapter 10, the investigation of lattice and spin interaction, and Chapter 12, the domain concepts and the hysteresis cycle, contain an especially large amount of new material. With the great interest in recent years in the field of magnetochemistry, the book will be valuable to teachers and students, not only in physics but also in chemistry.

The Measurement of Radio Isotopes. Denis Taylor. New York: Wiley; London: Methuen, 1951. 118 pp. \$1.50.

This is another in the series of useful Methuen monographs on various topics in the physical sciences. It is a review, directed toward the nonspecialist, of techniques used in the measurement of radioactive materials. Within the scope of a hundred-odd pages the author covers in a relatively thorough manner such topics as the radioactive decay laws; various types of measuring instruments and counting systems; statistics, geometry, and correction factors in measurements; health physics; and, very briefly, some of the more recently developed detection techniques.

It is perhaps regrettable that the author chose to enlarge upon the construction details of G-M counting systems and to make only brief mention of scintillation and proportional counters. As is implied in the preface, however, the G-M counter is still the most useful instrument for the individual toward whom the book is directed.

Nuclear physicists may take issue with the lack of rigor in various phases of the discussion, and American readers in general may find some difficulty with the British technical jargon. Nevertheless, the book will prove a useful reference for anyone dealing with radioactivity, as well as a concise handbook for technicians in this work.

Scientific Book Register

The Terpenes: The Sesquiterpenes, Diterpenes and their Derivatives, Vol. III. 2nd ed. Sir John Simonsen and D. H. R. Barton. New York: Cambridge Univ. Press, 1952. 579 pp. \$10.00.

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Introduction to Geology (Branson and Tarr). 3rd ed. Rev. by Carl C. Branson and W. D. Keller. New York-London: McGraw-Hill, 1952. 492 pp. \$5.50.

*If you prefer the "principles"
approach to general biology, See. . .*

MARY S. GARDINER'S

THE PRINCIPLES OF GENERAL BIOLOGY

PROFESSOR GARDINER, Bryn Mawr College, presents in her new text, a broad general review of the principles underlying biological concepts and methods. This is a principles type of book rather than a descriptive statement of factual material. Throughout, physiology of function is stressed.

THE BOOK IS DIVIDED into four main parts. The first deals with the physical and chemical bases of biological structures and operations; the second with the relationships of living things to the physical world and the organization of biological types; the third with the functioning of biological systems (nutrition, metabolism, growth, inheritance, and reproduction); the fourth with the evolution of biological systems. Emphasis is placed on the unity underlying all living things, their diversity in architectural plan, yet basic similarities and common origins.

Most of the chapters are units in themselves and the instructor can omit certain chapters if he wishes.

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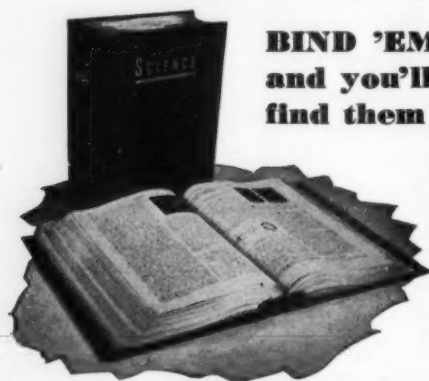
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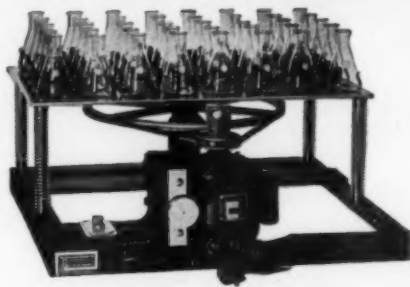
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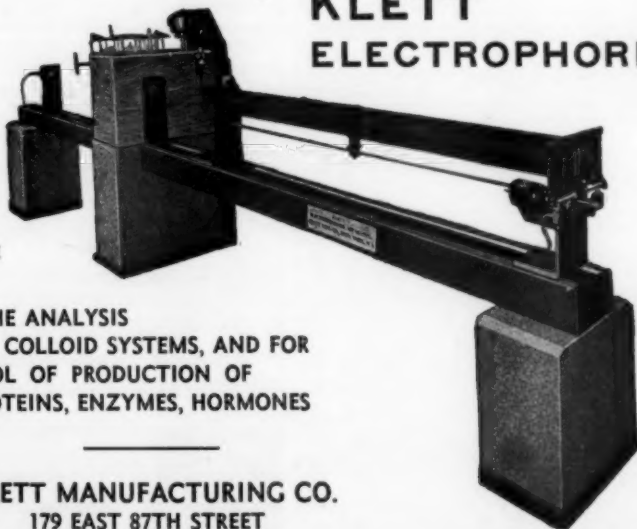


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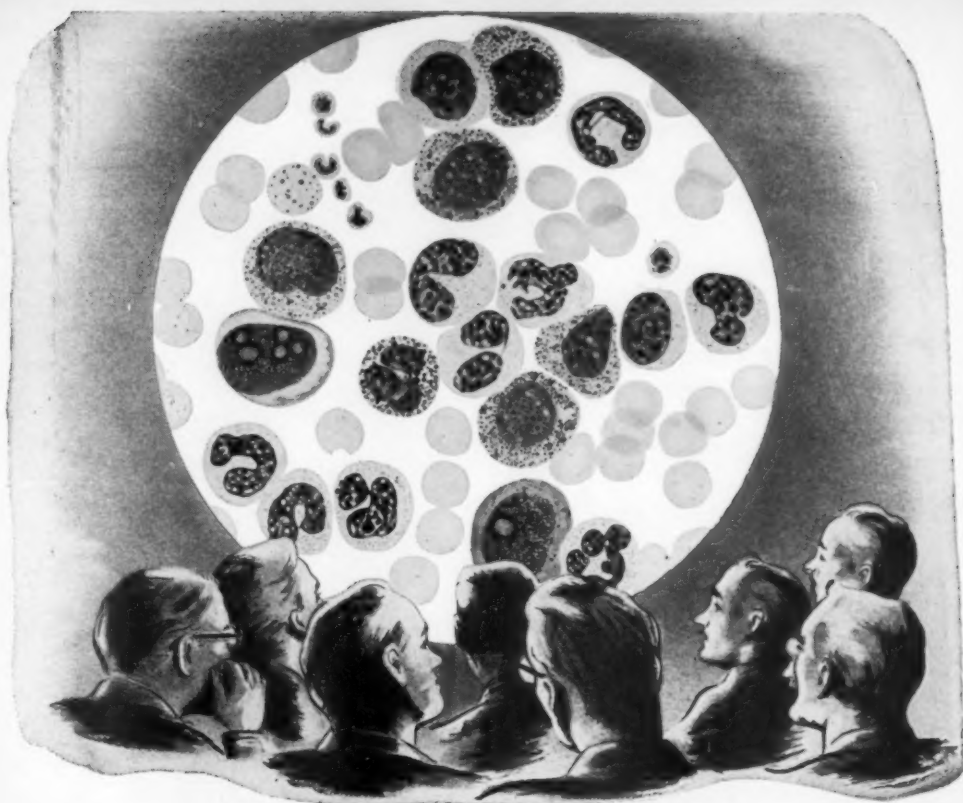
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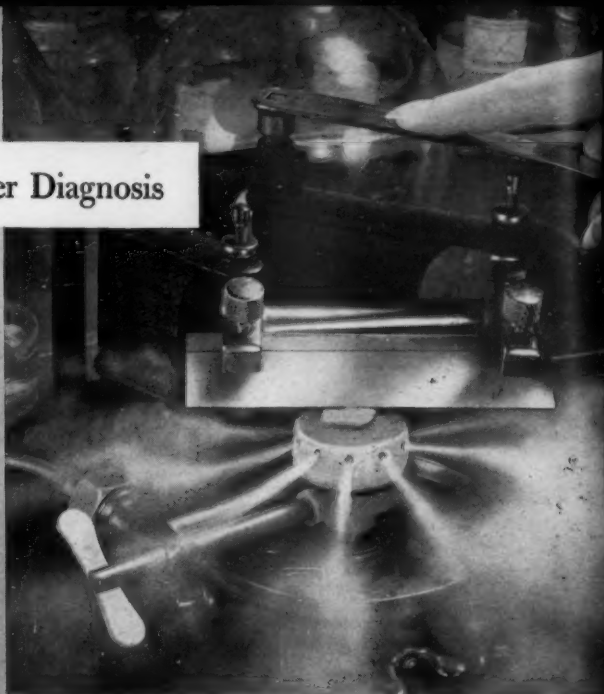
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